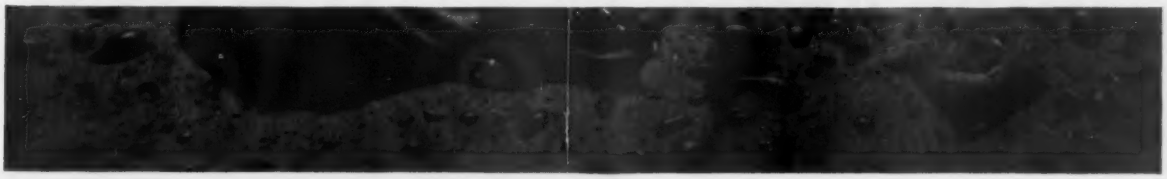
News about

B.F.Goodrich Chemical *raw materials*

HYCAR 1002



Even after years of research and development, there is no substitute for the excellent water resistance contributed by one of the original nitrile polymers, Hycar 1002. This unusually clean rubber proves ideal in applications where water may be a problem.

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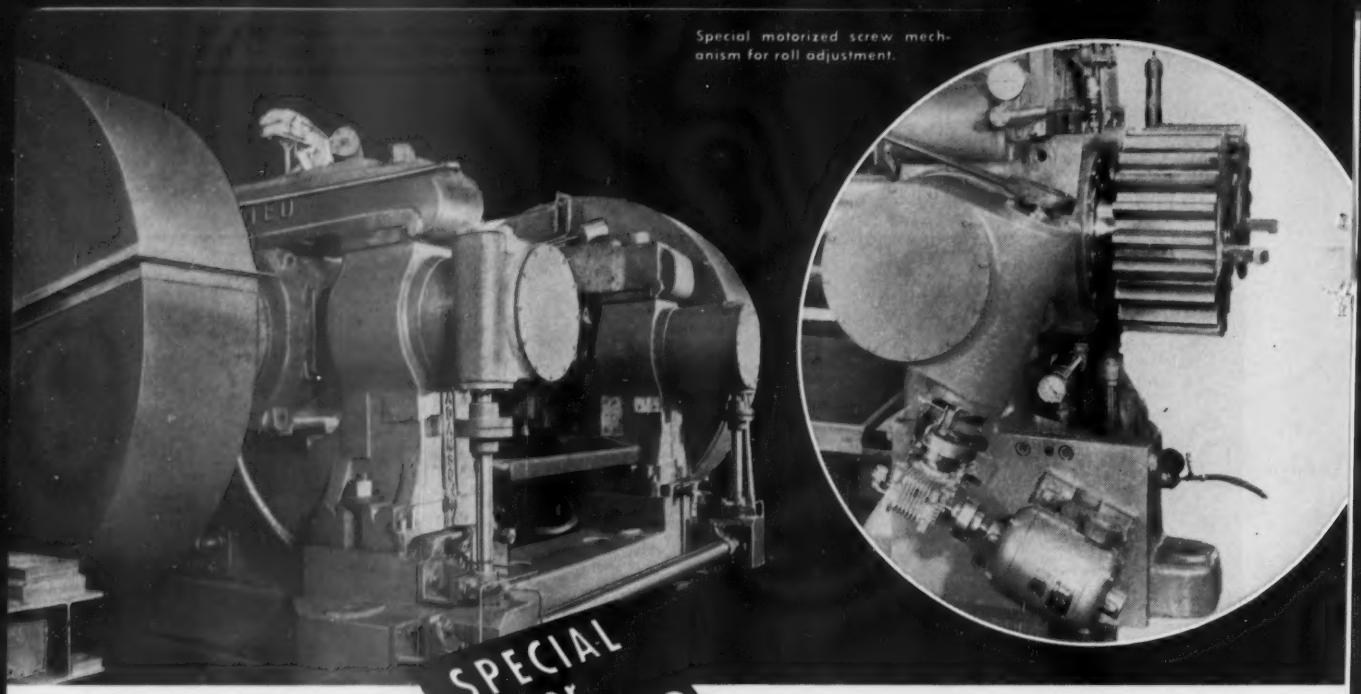

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A STANDARD MILL may be all you need. But often the kind of stock to be processed, temperature, gage and production rate, may require an entirely new type of specially designed mill.

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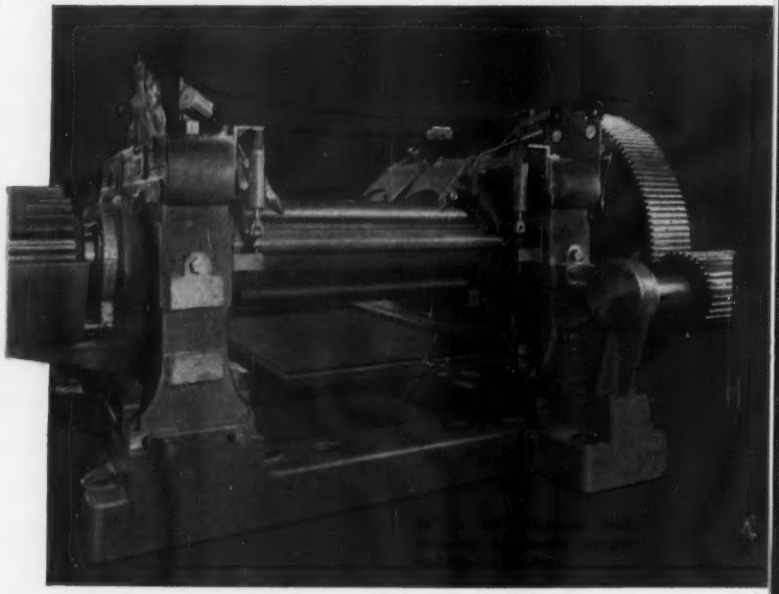

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Rubber Age

COVERING THE MANUFACTURE OF RUBBER AND RUBBERLIKE PLASTICS PRODUCTS

MARCH, 1959 VOL. 84 NO. 6

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959 New Developments in Elastomers: A Symposium

What five speakers told a recent meeting of the Southern Rubber Group about current developments in commercially available rubbers.

978 How to Handle Employee Grievances

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Highlights Sidelights *of the News...*

March, 1959

Committee D-11 on Rubber and Rubberlike Materials of the American Society for Testing Materials met on February 4 through 6 in Pittsburgh, Penna., in conjunction with the parent organization's Committee Week...Two technical papers were presented at the meeting...In one, A. E. Juve (Goodrich) discussed Mooney Cure Tests for Calculating Curing Times... The other, on The Langleys, was presented by Cole Caryl (Desert Sunshine Exposure Station). Almost all D-11 subcommittees met during the three-day meeting (page 980).

Firestone is constructing what is said to be the world's first plant for the production of Diene and Coral rubbers at its Petrochemical Center in Orange, Texas...Preliminary engineering work has already been completed for the plant which will have an annual capacity of 30,000 long tons of either type (page 987).

Aluminum Co. of America has announced plans to acquire the Rome Cable Co. through an exchange of 355,226 Alcoa shares... Agreements reached between the two firms will permit distribution to Rome Cable shareholders of three shares of Alcoa common for each five shares of Rome Cable common...Rome Cable stockholders will vote on the proposal on March 25 (page 990).

Polymer Corp., Ltd., Sarnia, Ont., Canada, has announced a 1959 capital budget expenditure of $6.6 million with $4.2 million slated for capital items related to improvement of plant efficiency and product quality; extension of employee facilities, and the continuation of a program for a waste disposal system...The 1959 budget also provides for the beginning of a butadiene plant in Western Canada (page 1012).

Rubber group meetings of interest during the past few weeks included the Southern Rubber Group (page 988) . . . the Northern California Rubber Group (page 991)...the Akron Rubber Group (page 992)...the Chicago Rubber Group (page 1001)...the Quebec Rubber and Plastics Group (page 1002)...the Elastomer and Plastics Group (page 1003)...the Ontario Rubber Section (page 1005)...and the Connecticut Rubber Group (page 1002).

U. S. Rubber has announced that its net income of $22,670,772 in 1958 was 24 per cent below its 1957 earnings...Net sales of some $870 million were approximately $3 million below the 1957 total...Goodyear suffered a 3.8 per cent sales decrease in 1958, but its earnings were the highest in the company's 60-year history (page 1006).

BUTAC NATAC TURGUM S AKTONE

for rubber reinforcing pigments, think of Huber

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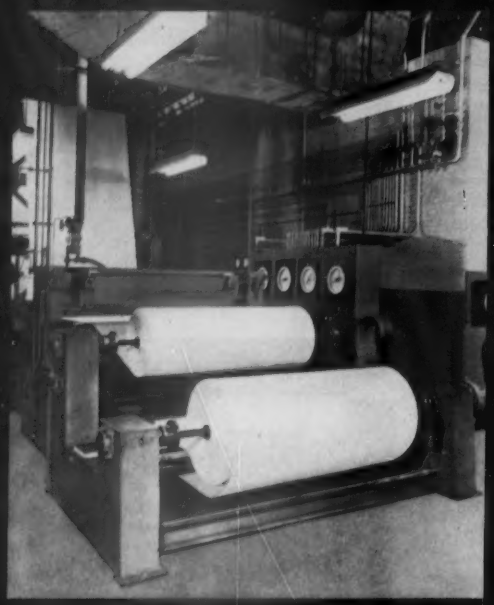
889



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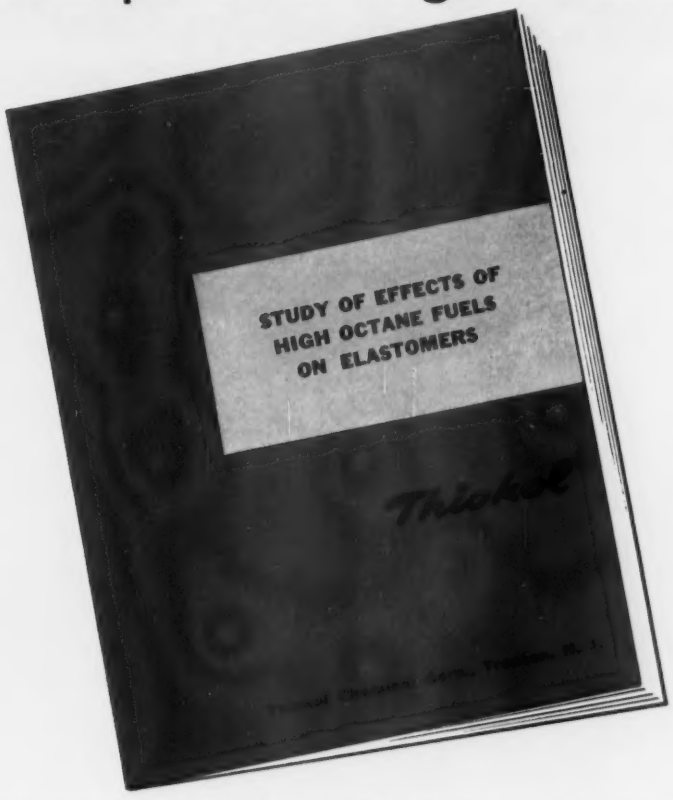
Research Underscores Need of New Approach to Manufacture of Hose and Other Rubber Equipment Exposed to High Octane Gasoline



Laboratory study shows dangerous degradation of present elastomers under new aromatic fuels

The trend to higher octane gasolines dictates a re-evaluation of rubber requirements – in the petroleum field – at refinery, transportation and service station levels. Exhaustive tests by THIOKOL point up the need.

Six different types of synthetic rubber now widely used – including THIOKOL ST and FA polysulfide crudes – were used for the tests. Immersed in fuels of varying aromatic content, from 25% to 100%, the elastomers were measured for volume swell, tensile strength, and low temperature properties. Most synthetics showed a marked reduction in physical properties and serviceability, while the THIOKOL crudes satisfactorily resisted "high octane rot."

The detailed results of this THIOKOL study hold great significance for suppliers in the rubber industry. Coupon will bring you a copy of the complete report.

FOR MORE INFORMATION:
Mail coupon to Dept. II, Thiokol Chemical Corp., 780 N. Clinton Ave., Trenton, N. J. In Canada: Naugatuck Chemicals Division, Dominion Rubber Co., Elmira, Ontario.

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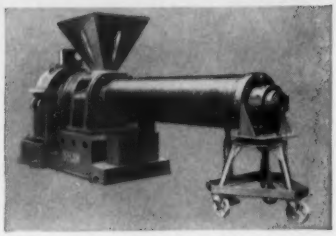

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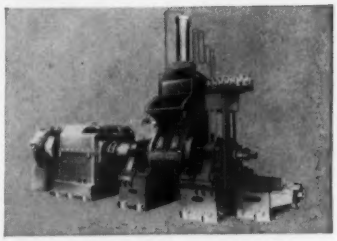

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P.1160

new avenues of opportunity

for rubber compounders are opening now—thanks to a new triple-action chemical from **GOODYEAR**

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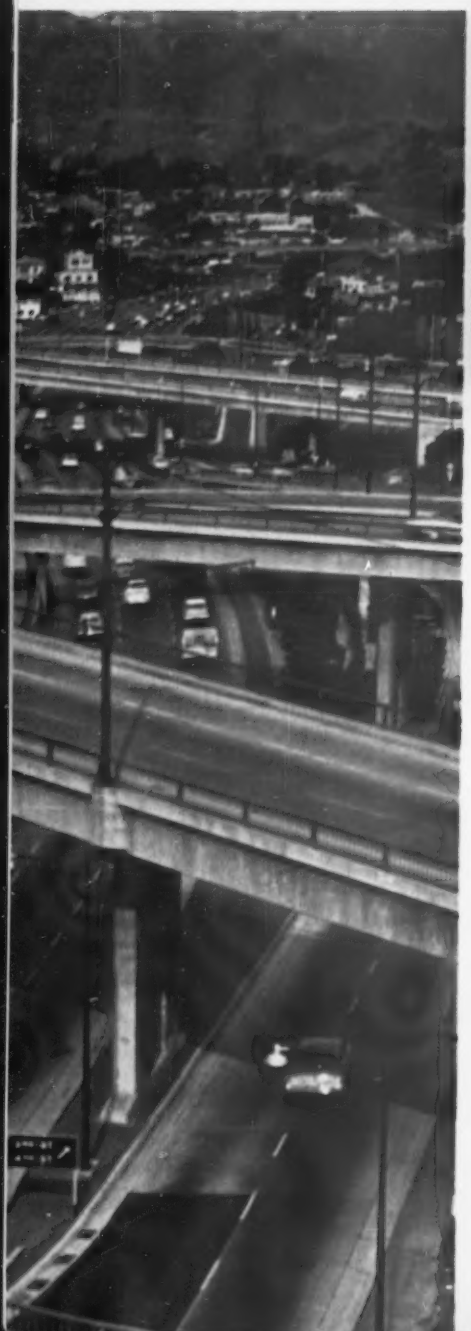
Now- GOODYEAR Chemical

first truly effective combination of stabilizer, mixed diaryl-p-phenylenediamine for rubber compounders in



AUTOMOTIVE PRODUCTS

MOLDED GOODS

Here's why new Wing-Stay 100 can mean better products at lower cost—

As a stabilizer for SBR rubbers—

WING-STAY 100 offers these advantages in discoloring-type polymers:

1. Incorporates in much the same manner as phenyl-beta-naphthylamine.
2. Provides resistance to oxidative degradation and flex-cracking which is much above the accepted minimum level.
3. Is vastly superior to standard stabilizers in antiozonant activity.
4. Serves as a better stabilization building block at no extra cost.

As an additive for SBR rubbers—

WING-STAY 100 provides these advantages—as a combination antioxidant and antiozonant—in synthetic rubbers:

1. Incorporates easily
2. Does not accelerate the cure
3. Does not bloom at normal levels
4. Provides much better over-all protection at lower cost

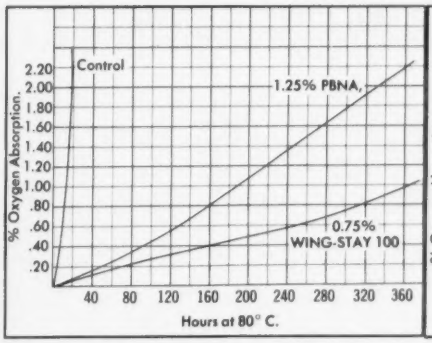
Division offers *Wing-Stay 100*

antioxidant and antiozonant. This nonvolatile opens **new avenues of opportunity** these major areas of application—

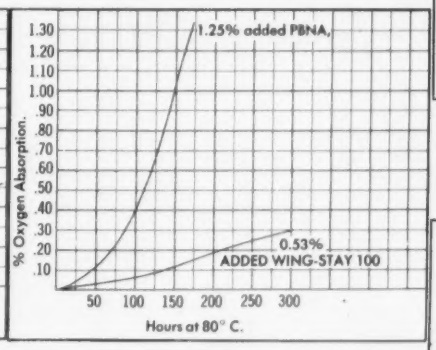
MECHANICAL GOODS

OR A VARIETY OF RUBBER PRODUCTS

Here's proof of new Wing-Stay 100 superiority—

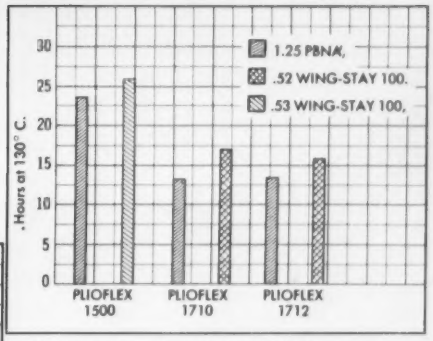


Effect of WING-STAY 100 on the stability of an Oil-Extended SBR Polymer.



Effect of WING-STAY 100 as added stabilizer in a "cold" nonextended SBR Polymer.

Creep Test on PLIOFLEX Polymers.*

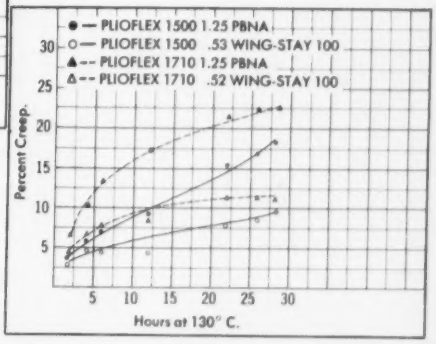


Vulcanized 50 Part HAF Black Compound—Hours to 10% Creep.

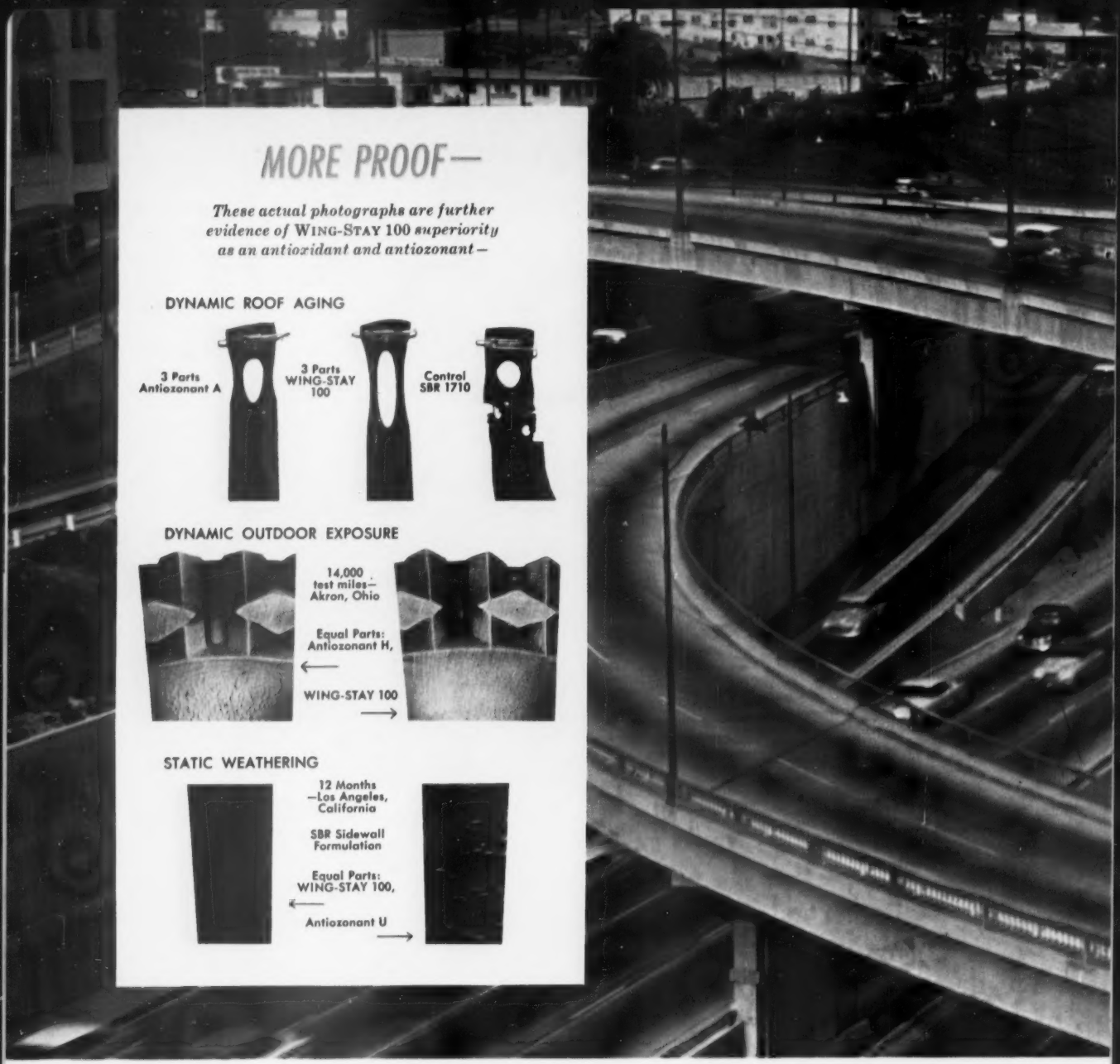
*A measurement of oxidative degradation of rubber in air at elevated temperatures.

Creep Test on PLIOFLEX Polymers. ▶

(Black Compounds containing Copper to magnify Oxidative Degradation)



And that's not all!



MORE PROOF—

These actual photographs are further evidence of WING-STAY 100 *superiority as an antioxidant and antiozonant—*

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DYNAMIC OUTDOOR EXPOSURE

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New *Wing-Stay 100* is available now in 3 PLIOFLEX rubbers

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The Carbon Arc Lamp in the Fade-Ometer produces radiation at the sample similar to sunlight, both as to intensity and spectral distribution.

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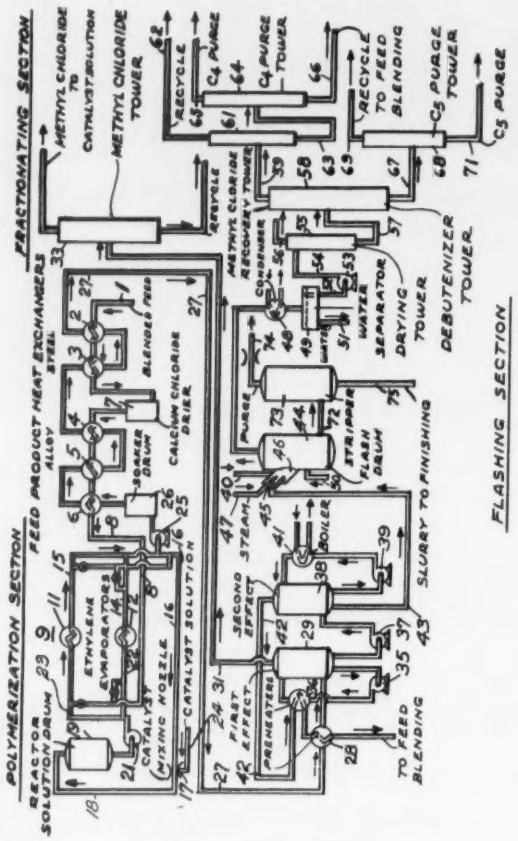
Manufacturers of accelerated testing equipment for over a quarter of a century.

PATENT REVIEW

by Melvin Nord

Solution Process for Synthetic Rubber

U.S. Patent 2,844,569, issued July 22, 1958 to Arthur D. Green, Edward J. Gornowski, Harold W. Scheeline, and Stanley E. Jaros, assigned to Esso Research & Engineering Co., describes a process for making isobutylene-diolefin synthetic rubber which utilizes a solvent for the olefinic monomers, which is also a solvent for the resulting polymer.



As shown in the schematic diagram, the feed mixture of isobutylene, multiolefin and solvent-diluent is supplied through a pipe line (1) to a series of heat interchangers (2-6) and through a calcium chloride dryer (7).

From the heat interchange coolers, the blended feed mixture is conveyed to a circulating polymerization system (9). This system consists of at least two ethylene-cooled chillers (11 and 12), one of which is connected to a position between

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CHALLENGE No. 1: It is 2 P. M. Friday. Mr. C. phoned a rush order for 100 pounds of Special Synthetic Rubber which he needed immediately for a test sample for an account.

RESULT: The 100 pounds was delivered by Muehlstein at 4:30 P. M. the same day, sixty-two miles away. The customer made his deadline.

CHALLENGE No. 2: Mr. D. called for a 200 pound sample of rubber not currently in the Muehlstein warehouse. The customer needed it immediately.

RESULT: Material was procured from another of Muehlstein's warehouses and delivered more than 100 miles away at 9 o'clock the next morning. These are only two typical examples of the effort expended by the Muehlstein organization to render the proper services to our customers.

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3 TANS
#10
#15
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9

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PATENT REVIEW

the primary coolers and the circulating system, while the other is connected to a nozzle device (17), which in turn is connected to a reactor drum (19). The reactor drum in turn is connected to a circulating pump (21) which is connected to the ethylene chillers (11 and 12). The catalyst nozzle (17) likewise is connected to the supply of catalyst solution.

The pump (25) provides the necessary pressure for discharge of polymerized solution from the circulating system (9) to the second side of the heat exchangers (6, 5, 4, 3, and 2). To the discharge outlet of the pump (25) there is connected a drum (26) which provides storage for the dilute polymer solution and permits completion of the polymerization reaction. The dilute polymer solution is then led through the heat exchangers in reverse flow to the direction of flow of the fresh feed.

From the last heat exchanger (2) the dilute warm polymer solution, under pressure sufficient to maintain liquid condition, is led through a pipe line (27) and through a preheater (28) in which the temperature is raised to or above the boiling point under the applied pressure. From this preheater, the dilute polymer solution is conducted to a disengaging drum (29) in which a very substantial portion of diluent and residual unpolymerized unsaturates are vaporized and discharged through a pipe line (31) to a fractionating system (33). This still recovers a major portion of the methyl chloride catalyst solvent.

The bottom from the column (33), consisting mainly of hydrocarbon solvent-diluent and unsaturates, is then conducted to a storage where it can be fortified with additional quantities of isobutylene and multiolefin and returned as blended feed to the pipe line (1).

Vaporization of solvent and rapid disengagement of volatiles in the drum (29) is effected by a circulating pump (35) which draws warm polymer solution from the bottom of the drum (29) and delivers it through a boiler (36) to the top of the drum (29) where a substantial portion evaporates and the remainder drains to the bottom of the drum. A pump (37) is connected to the bottom of the drum (29) to withdraw a substantial portion of the warm solution and deliver it to a second disengaging drum (38). The drum is provided with a circulating pump (39) and a boiler or heat exchanger (41), preferably heated by steam. This second drum, heater and circulating pump completes the concentration of the polymer solution to the thickest flowable consistency.

The disengaged hot vapors from the drum (38) are sent back to the heaters (36 and 28). The thick residual solution from the drum is dis-

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charged to a flash drum (44). The thick warm polymer solution from a pipe (43) is delivered through a nozzle (45) into a receiving pipe (46), into which a steam line (47) also enters, both being connected to the drum (44). The steam line (47) is connected to a steam jet within the member (46) which breaks up, atomizes and heats still further the stream of concentrated polymer, and reduces the partial pressure of the solvent vapor by the dilution effect.

The vaporized material from the flash drum (44) is delivered to a condenser (48) to condense the residual diluent and residual monomers. The pressure in the drum (44) is maintained sufficiently high to permit condensation of this steam with cooling water.

In the tower (55) traces of water dissolved in the solvent are removed by distillation and discarded overhead through a pipe (56). The bottoms from the tower (55) then consist of primarily C_4 and C_5 hydrocarbons, substantially free from moisture. The bottoms are delivered to a second fractionating tower (58) in which all of the butenes and a little n-butane are taken overhead to the methyl chloride recovery tower (61), from which the overhead consists of methyl chloride not evaporated in drums 29 and 38 and some C_4 material, which is returned to the feed-blending tank for recycle to pipe 1. The bottoms from the tower (61) are taken to another tower (64), the overhead from which is a C_4 stream rich in butene 1, a reaction poison, which is purged through a discharge pipe (65). The bottoms, consisting of relatively pure butane and isobutylene, are discharged to the feed mixing system for recycle. The bottoms from the fractionating tower (58), containing substantially all of the isoprene and the bulk of the n-butane fed to the tower, are led to a fractionating tower (68), where high boiling impurities are purged as bottoms and discarded while the purified isoprene and n-butane is taken off overhead to the feed blending tank for recycle to pipe 1.

Particle Size of Synthetic Rubber Latices

U.S. Patent 2,839,483, issued June 17, 1958 to Louis H. Howland and Alfred Nisonoff, assigned to United States Rubber Co., describes a method of increasing the particle size of synthetic rubber latices by utilizing volatile salts of ammonia or amines.

The latex originally contains an alkali-metal soap and the volatile salt. The salt decomposes on heating, liberating the ammonia or amine, which is removed by distillation. The acid thus released from the salt reacts with the soap to free the soap-forming acid, and reduces the pH without coagu-

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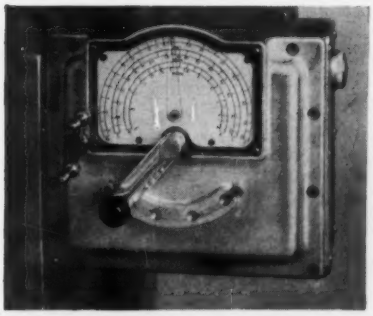
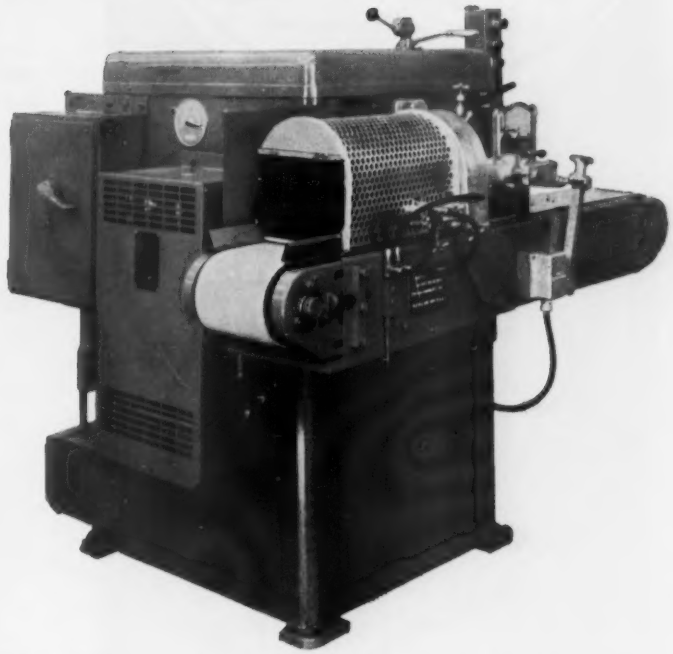


This newly-designed, finger tip controlled metering unit provides three intermittent cutting ranges —enabling selection of lengths from 1/2-inch to 60 feet. Scale is graduated in feet and inches which makes for precise, rapid setup—simple to operate. (Patent Pending)



Model M-420 Universal *is a completely automatic machine for both continuous and intermittent cutting. The built-in metering conveyor elements transport the uncut stock to the knives, precisely measure the length of cut and move the cut stock away from the blades. Wink actually measures while it cuts from four points simultaneously. It does not depend upon timing or synchronization with another unit or machine—does not cut against a dead element but against another live knife.*

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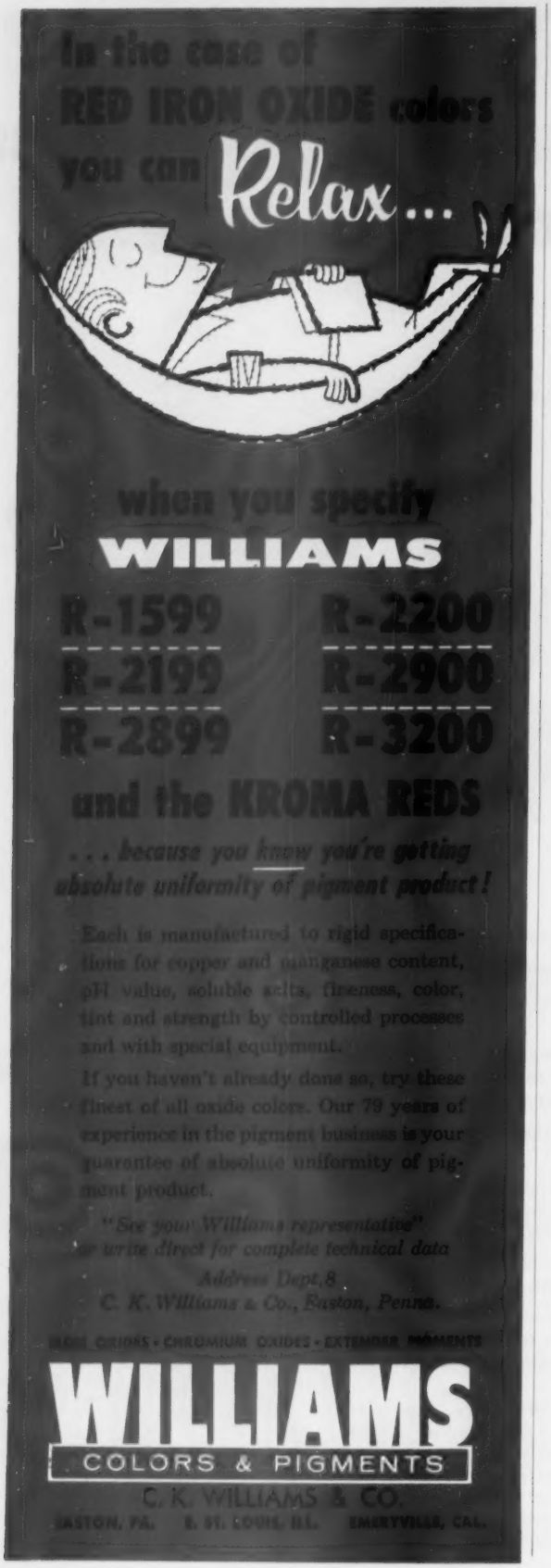
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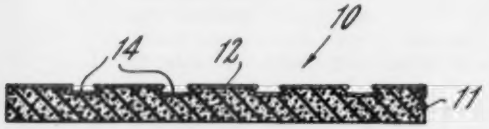
lating the latex. The treated latex is then heated for an hour at 40 to 100°C., thus increasing the particle size of the latex.

Cushioning Material

U.S. Patent 2,853,411, issued September 23, 1958 to Nelson F. Riley, assigned to United States Rubber Co., describes a flexible elastic cushioning material having a lamina of stretchable water-repellent paper bonded to a lamina of elastic sponge rubber. It is particularly useful as a rug underlay.



As shown in the drawing, the cushioning material (10) consists of a lamina (11) of sponge rubber, which is intimately bonded to a lamina (12) of universally stretchable water-repellent paper. The universal stretch may be produced in the paper by forming small wrinkles in it transverse to the strip and then forming corrugations (14) in the strip longitudinally. The wrinkles may be formed in the paper by the conventional creping process, and the corrugations may be formed by running the paper longitudinally between a grooved roll and rollers fitting into the grooves after the paper has been creped.

The paper lamina (12) is then rendered waterproof by impregnating it with a water-repellent wax which is compatible with the sponge rubber lamina (11), and which is insoluble in water.

Other Patents of Interest

Subject	Assignee	Patent No.	Date
Method of preserving a rubber	Monsanto Chemical Co.	2,841,627	7/1/58
Antiozonants for rubber	Firestone Tire & Rubber Co.	2,841,628	7/1/58
Process for obtaining grain-free polystyrene latices	Monsanto Chemical Co.	2,842,511	7/8/58

Copies of any patents, including those described here, are available from the Commissioner of Patents, Washington 25, D. C., for 25 cents each. Do not send stamps.

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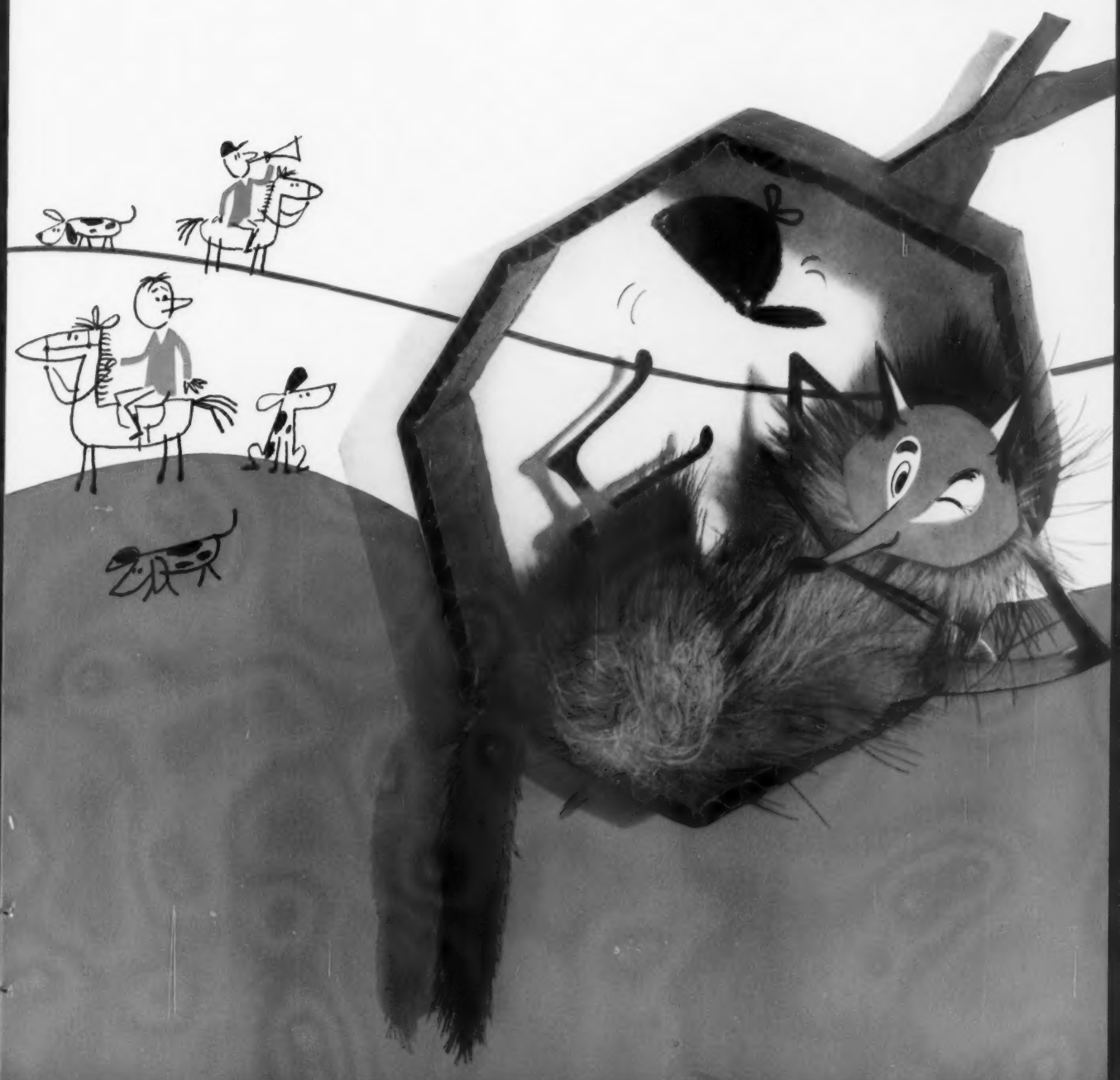

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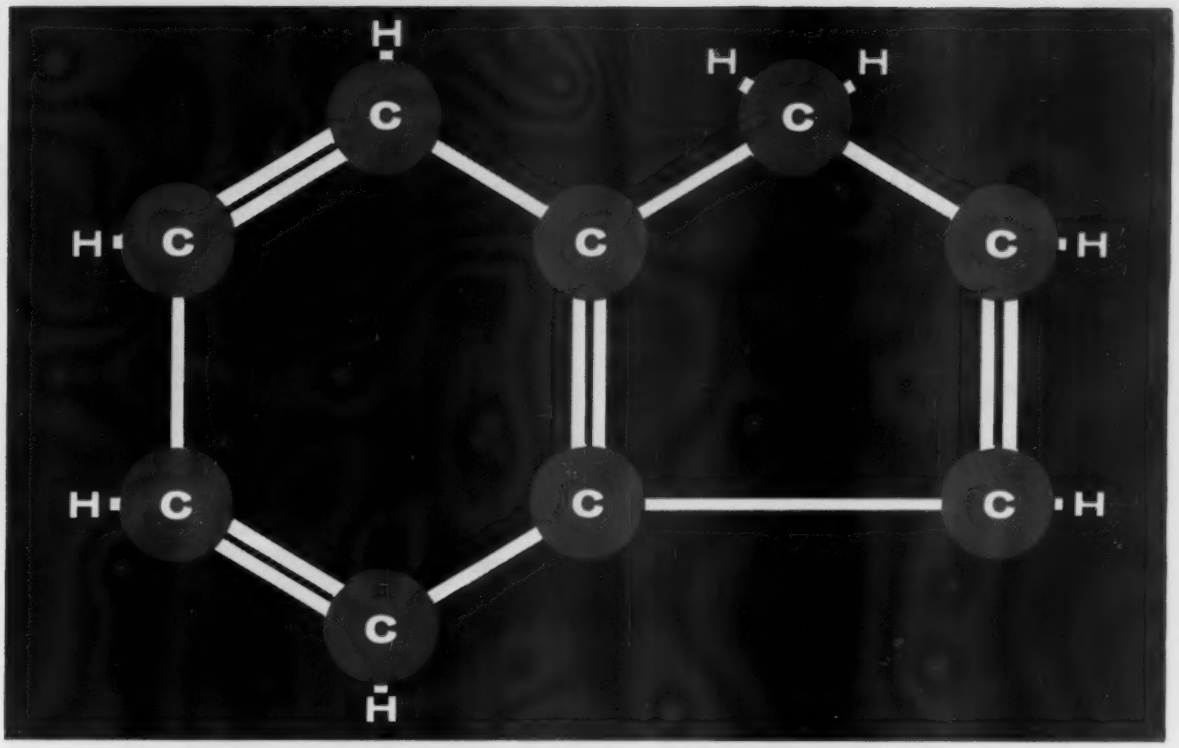

Neville Announces Production of HIGH PURITY INDENE

Neville is now in semi-commercial production of high-purity indene. It is a mobile, almost water-white, high boiling liquid, similar in appearance to monomeric styrene. The big potential interest in this new chemical lies in the fact that it has two reactive centers—the double bond and the methylene group—both in the five-membered ring fused to the benzene nucleus. Indene will polymerize or react to form a wide range of useful intermediates. Potential uses are indicated in the fields of polyesters, synthetic rubbers, copolymers, insecticides and repellants, drugs, dyes, plasticizers, antioxidants, surface active agents and synthesis of steroids and vitamins. Use your letterhead or the coupon below to write for a bulletin and sample.

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Purity, % by Wt.	97.5
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Specific Gravity 60/60°F.	1.0002
Refractive Index (n^{25}/D)	1.5726
Distillation Range (IBP-EP), °C.	180.0-186.0
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Color (Saybolt)	+21 (inhibited)

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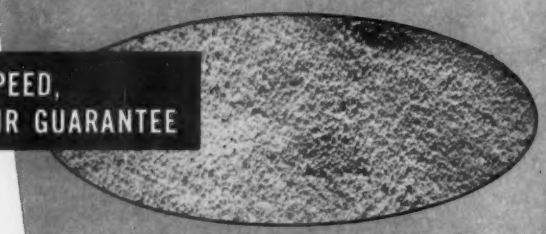

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The tonnage production of zinc oxide could make the ordinary 6 to 8 hour routine oxide analysis by standard wet lab methods costly to both producer and consumer. If metallic impurities are not eliminated immediately, the 6 to 8 hour interim between oxide sampling and a complete analysis can easily result in tons of off-standard oxide.

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2 . . . the sample preparation room. There 4 cc. of the oxide sample is sealed in a small envelope and put in a pneumatic tube carrier. In less than one minute the Lamson airtube system delivers the sample to . . .

3 . . . the Direct Reading Spectrometer Laboratory. Analyst Dick Halfhill thoroughly mixes equal weights of oxide and electrically conductive graphite and makes test electrodes by packing the mixture into four metal tubes as shown above. These electrodes are taken to an adjoining room housing . . .

4 . . . the Baird DR Spectrometer. Two specimen electrodes are properly spaced in the spectrometer's holders, the door is closed, a button is pushed and extremely high voltage creates an arc across the electrodes. As elements are burned, light from the arc is broken into element lines of varying light energy. This energy directed to photomultipliers (photosensitive electronic tubes) is converted to electrical energy which actuates . . .

5 . . . pre-calibrated dials that read elements present DIRECTLY IN PERCENTAGES. In five minutes, four specimens can be completely analyzed for copper, manganese, lead, iron, silica, cadmium, indium, aluminum and silver. The four analyses are averaged out and entered on the specimen report. Two minutes later via return air tube . . .

6 . . . Superintendent Bugher knows the exact nature of in-process zinc oxide. TOTAL ELAPSED TIME FROM COLLECTION OF SAMPLE—**16 MINUTES!** Changes in the smelting phase, if any are required, can be made immediately — impure oxide destined for reprocessing is held to an absolute minimum — **nothing but oxide of the highest obtainable quality reaches the packing stations.**

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News in Brief

► Ernest F. Fullam, Inc., Schenectady, N. Y., has published a brochure and catalog that lists accessories for the entire microscope field.

► Enjay Co., Inc., New York, N. Y., has announced the availability of Enjay Bulletin No. 6, "Dynamic Properties & Applications of Enjay Butyl," and Bulletin No. 7, "Enjay Butyl for Appliance Applications."

► Harwick Standard Chemical Co., Akron, Ohio, has released a bulletin that lists the new plasticizer ratio for "Stan-Tone Paste Colors." The company has also recently revised the "Thixon Primer P-2" bulletin in order to give more up to date information.

► A concentrated paste of synthetic pearl that simplifies the use of pearl for vinyl processors has been developed by Claremont Pigment Dispersion Corp., Roslyn Heights, L. I., N. Y.

► Martin Rubber Co., Inc., Long Branch, N. J. has appointed Coursey & King, Atlanta, Ga., as their exclusive toy representatives for the southeastern states.

► A new multi-low-range universal tester is described in an illustrated six-page folder released by W. C. Dillon & Co., Inc., Van Nuys, Calif.

► Martin Rubber Co., Inc., Long Branch, N. J., has published a new catalog that introduces "Water Wizards" a new line of pure white rubber fins, masks, goggles and snorkels.

► Heard what is being done with carbon black lately? The Naval Weather Service has been experimenting with black as a cloud seeding device as well as a cloud dissipation device. The Navy reports that favorable results have been obtained. Didn't say whether HMF, ISAF of GPF blacks were used—just like the Navy to leave out the most interesting part!

► A new eight-page data sheet describing the properties and uses of "Union Carbide" Silicone Compounds of the 520 series may be obtained by writing for Form SF-1010A to the Silicones Division, Union Carbide Corp., 30 E. 42nd St., New York 17, N. Y.

► Complete information on gate pressure reducing valves developed by the Jordan Industrial Sales Division of the OPW Corp., 6013 Wiehe Road, Cincinnati, Ohio, to give dead end shut-off on all fluid services has been presented in a 6-page report, Bulletin J-160.

► Thiokol Chemical Corp., Trenton, N. J., has published two new studies on dimethylol phenol resins as vulcanizing agents for butyl rubber. "Bulletin 100-4" describes this system using Amberol ST-137 phenol formaldehyde resin and "Bulletin 100-4B" contains an evaluation of the use of commercial dimethylol phenol resins other than Amberol ST-137.

► B. F. Goodrich Tire Co., Akron, Ohio, has published a 1958 edition of the "Farmer's Handbook and Almanac," designed to be helpful to farmers and their families.

► Three new tire repair kits, designed for "Dill'co" nylon-reinforced, self-curing, chemical patches, have been announced by the Dill Manufacturing Co., Cleveland, Ohio.

► Silicone Products Department of the General Electric Co., Waterford, N. Y., has issued two new bulletins: "CDS-129," a new eight-page catalog which describes the major G-E silicone products and some of the many uses for them, and "CDS-104," a four-page bulletin discussing Class 900 silicone rubber for wire and cable insulation.

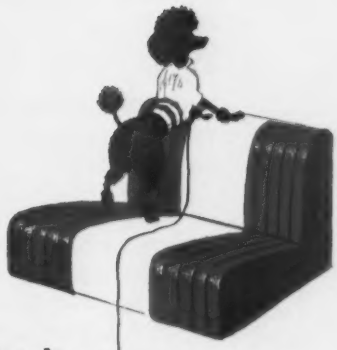
► Standard-Thomson Corp. of Waltham, Mass., has announced that production has begun of the "HP" auto radiator thermostat which utilizes as an actuating mechanism, a metal cartridge enclosing a molded Hycar rubber sleeve, supplied by B. F. Goodrich Chemical Co.

► "HydroPool," a water, alkali and chemical resistant paint made from Goodyear "Pliolite S-5" and developed for swimming pool use, has been introduced to consumer markets by Iowa Paint Manufacturing Co., Inc., Des Moines, Iowa.

► Mayer Refrigeration Engineers, Inc. of Lincoln Park, N. J., have published a bulletin which describes the new "Water Economizer," a water and recirculating-cooling unit.

► A comprehensive 24-page brochure on the Infracord double beam infrared spectrophotometer has been published by the Instrument Division of the Perkin-Elmer Corp., Norwalk, Conn.

► Slomons Laboratories, Inc., Long Island City, N. Y., is marketing a "Big Three Miracle Adhesives Kit" that is said to solve practically all the gluing and repair problems that confront the average home owner.



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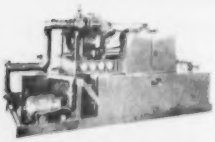

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CW-1015 and other Chemical-Loaded Molecular Sieves offer marked improvements in compounding natural rubber, neoprene, butyl rubber, silicones, etc.

Technical service, sales, samples, data sheets for Linde Chemical-Loaded Molecular Sieves in rubber and plastic application is handled by Harwick Standard Chemical Company, Akron, Ohio. All inquiries regarding these unique delayed action accelerators should be directed to: Harwick Standard Chemical Co., 60 South Seiberling Street, Akron 5, Ohio.

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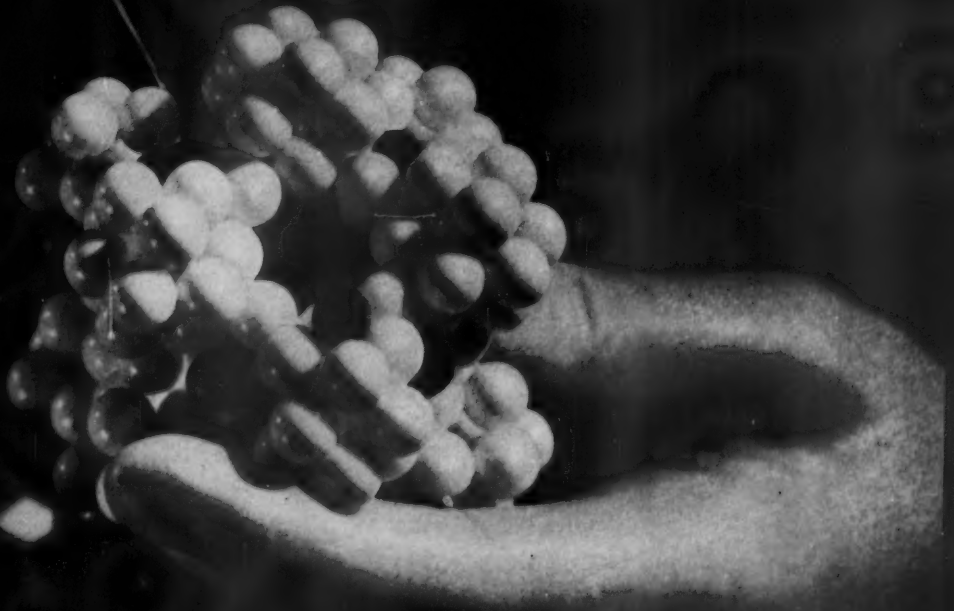

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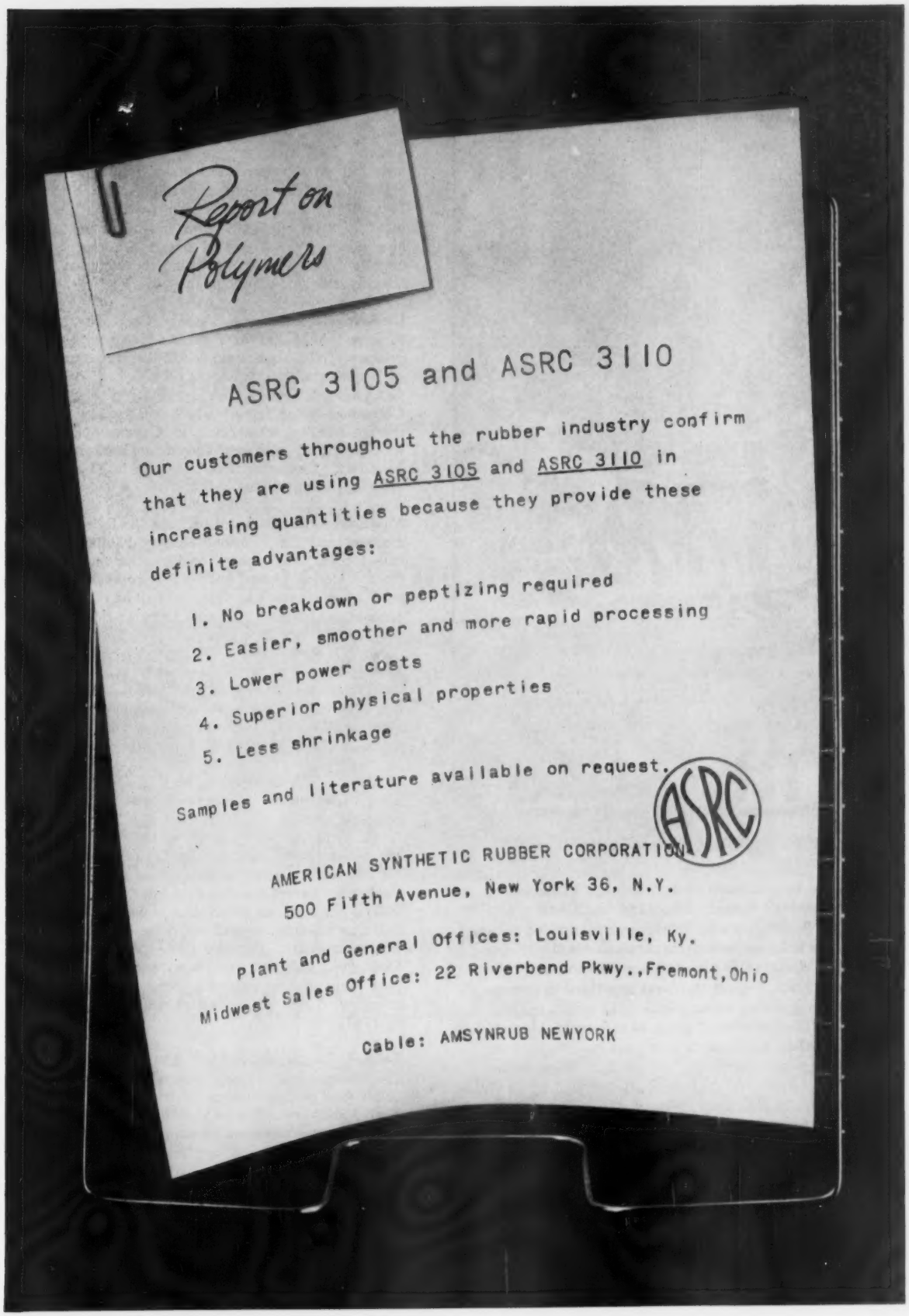
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Overseas

Tokyo—The Japanese government has approved a technical service agreement under which the U. S. Rubber Co. will supply technical assistance to the Nitto Tire Co. of Tokyo, Japan, for the production of all types of pneumatic tires and tubes. Nitto will also produce U. S. Royal brand tires for export sale by U. S. Rubber, providing the company with a base for expanded business in Asia.

Canberra—International Finance Corp. has agreed to invest $225,000 in Rubbertex (Australia) Proprietary, Ltd., Melbourne, Australia, for expansion of manufacturing operations.

Columbo—A tire factory which will use raw Ceylon rubber will be constructed in Ceylon by Russia, in accordance with an agreement between those countries. Russia has also agreed to build a 30,000 ton steel rolling mill in Ceylon.

Monrovia—An agreement between the Liberian government and the Firestone Rubber Plantations Co. calls for a 35 per cent tax on Firestone's net income from Liberian operations. The company, which paid 25 per cent last year, said it had taken into account, and wished to assist, Liberia's development program.

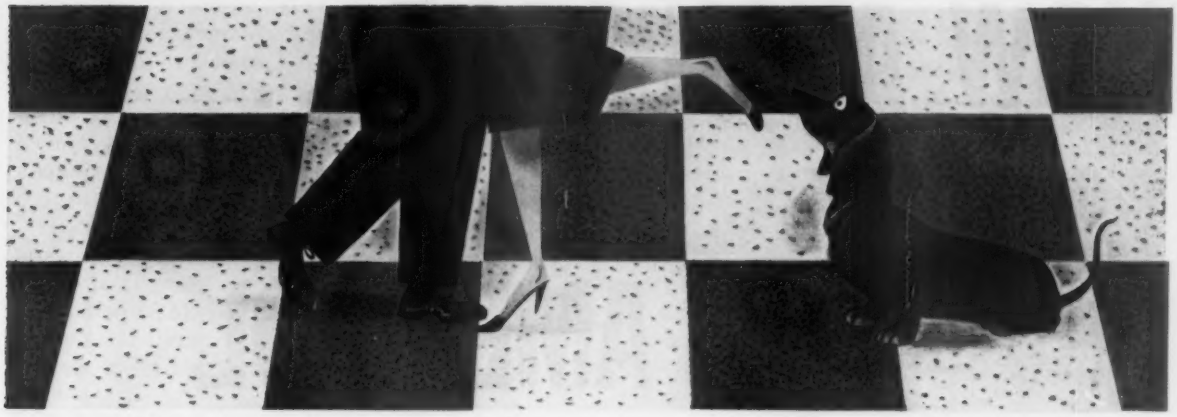
Rome—Chatillon Spa., an Italian firm, plans to build and equip a $40 million plant for the production of synthetic fibers for automobile tires in Saratow, Russia. Operations at the 50,000 kg. per day plant, are expected to begin within two years.

Bonn—A dehydrogenation plant designed to produce 36,000 metric tons of butadiene annually, has gone on stream at the Chemische Werke Huels, A. G. in Marl, West Germany. Other similar units are under construction in Japan and Italy.

Canberra—Dow Chemical Co. and C. S. R. Chemicals, Pty., Ltd., an Australian chemical firm, plan to form a jointly owned company for the production of styrene. The new unit, to be called CSR-Dow, Pty., Ltd., will build a styrene monomer plant near Melbourne as part of a four-unit petrochemical complex. Construction is expected to be completed by 1961.

Tokyo—The Japan Rubber Association has set a 10 per cent hike in rubber product export as this year's goal and is aiming for a shipment figure of 22,000 tons valued at $57,800,000. The Association's decision to boost its export target was based on an anticipated increase in volume of business from the United States in particular.

Johannesburg—A South African Section of the Institution of the Rubber Industry will be formed to promote development of polymer science and technology; encourage technical education; and provide means of association between persons engaged in the rubber industry in South Africa.



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TYPE 4650

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TYPE 4651

A high dispersion carbon black masterbatch consisting of HAF black in a rosin acid emulsified cold polymer. Composition: Type 1500 Ameripol, 100 parts; HAF black, 62.5 parts; heavy processing oil, 12 parts. For tires, premium quality tread rubber, mechanical goods, extruded goods.

TYPE 4652

A high dispersion carbon black masterbatch with a high loading of medium thermal black in a rosin acid emulsified cold SBR copolymer. Composition: Type 1501 copolymer, 100 parts; medium thermal carbon black, 150 parts. For mechanical goods, floor matting.

TYPE 4654

A high dispersion carbon black masterbatch of ISAF black in a rosin acid emulsified cold SBR copolymer. Composition: Type 1500 copolymer, 100 parts; ISAF black, 52 parts; heavy processing oil, 10 parts. For tires, premium quality tread rubber.

TYPE 4655

A high dispersion carbon black masterbatch of HAF black in a rosin acid emulsified SBR copolymer. Composition: Type 1500 copolymer, 100 parts; HAF black, 52 parts; heavy processing oil, 10 parts. For tires, premium quality tread rubber, mechanical goods, extruded goods.

TYPE 4750

A high dispersion carbon black masterbatch of HAF black in a highly aromatic oil extended, mixed acid, SBR copolymer. Composition: Type 1712 oil extended copolymer, 137.5 parts; HAF black, 75 parts. For tires, medium quality tread rubber.

TYPE 4751

A high dispersion carbon black masterbatch of FEF black in a naphthenic oil extended, all fatty acid, SBR copolymer. Composition: Type 4700 oil extended copolymer, 150 parts; FEF black, 100 parts. For low cost tread rubber, automotive extrusions, mechanical goods, floor matting.

Now you can select the right black masterbatches for your particular products from *seven* high-dispersion types offered by Goodrich-Gulf.

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New data book—For complete information on all seven of these black masterbatches, write for new illustrated Micro-Black data book.

Goodrich-Gulf Chemicals, Inc.

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	Type 4650	Type 4651	Type 4652	Type 4654	Type 4655	Type 4750	Type 4751
Chemical Properties							
Volatile matter, %	0.11	0.12	0.05	0.12	0.12	0.15	0.09
Ash, %	0.28	0.32	0.13	0.20	0.14	0.31	0.19
Rosin acid, %	3.83	3.74		3.84	3.81		
Rosin soap, %	0.01	0.01	0.00	0.01	0.00	0.04	
Organic acid, %			2.48				
Mixed acid, %						2.77	
Fatty acid							2.16
Physical Properties (Cure 50′ @ 292° F.)							
Tensile, psi.	3315	3389	1660	3950	3370	3340	2265
Elongation, %	547	474	470	650	655	660	440
Modulus, 300%, psi.	1742	2243	1200	1400	1295	1380	1650
Hardness, Shore A	64	68	64	65	60		66
Compound viscosity, ML4 @ 212° F.	60	69	82	54	52	72	79
Test Recipe							
Ameripol	150.0	156.0	250.0	147.5	147.5	154.5	166.5
Zinc oxide	5.0	5.0	5.0	5.0	5.0	1.5	5.0
Sulfur	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Stearic acid	1.5	1.5	1.5	1.5	1.5	—	—
Benzothiazyldisulfide	2.0	2.0	2.0	2.0	2.0	1.0	1.5
	160.5	166.5	260.5	158.0	158.0	159.0	175.0

NOTE: Above data based on the test recipes indicated. They are given for information only, as we cannot accept responsibility for operations not under our direct control.

COMING EVENTS

March 20. Boston Rubber Group, Spring Technical Meeting, Somerset Hotel, Boston, Mass.

March 20. New York Rubber Group, Technical Meeting, Henry Hudson Hotel, New York, N. Y.

April 3. Akron Rubber Group, Sheraton Hotel, Akron, Ohio.

April 5-10. American Chemical Society, 135th National Meeting, Boston, Mass.

April 5-10. 1959 Nuclear Congress, Cleveland Auditorium, Cleveland, Ohio.

April 6. Washington Rubber Group, Spring Meeting.

April 7. Los Angeles Rubber Group. Meeting sponsored by W. J. Voit Rubber Corp., Biltmore Hotel, Los Angeles, Calif.

April 7. Ontario Rubber Group, Pickfair Restaurant, Mimico, Ontario, Canada.

April 7-8. Building Research Institute, 8th Annual Meeting, Penn-Sheraton Hotel, Pittsburgh, Penna.

April 9. Northern California Rubber Group.

April 9. Rhode Island Rubber Group, Spring Meeting, Pawtucket Country Club, Pawtucket, R. I.

April 16. Fort Wayne Rubber & Plastics Group, Spring Meeting, Van Orman Hotel, Fort Wayne, Ind.

April 16. Quebec Rubber & Plastics Group, "Rubber & Plastics Extrusion," Montreal, Canada.

April 17. Detroit Rubber and Plastics Group, Spring Meeting, Detroit Leland Hotel, Detroit, Mich.

April 24. Chicago Rubber Group, Furniture Club, Chicago, Ill.

May 1. Joint International Meeting, Buffalo Rubber Group-Ontario Rubber Section, CIC, Hotel Sheraton-Brock, Niagara Falls, Ont.

May 1. Philadelphia Rubber Group, Poor Richard Club, Philadelphia, Penna.

May 4. Washington Rubber Group, Technical Meeting.

May 7. Northern California Rubber Group.

May 12-15. Division of Rubber Chemistry, ACS, Spring Meeting, Biltmore Hotel, Los Angeles, Calif.

May 14. Los Angeles Rubber Group, meeting in conjunction with ACS, Beverly Hilton Hotel, Beverly Hills, Calif.

May 22. Connecticut Rubber Group.

May 25-27. Chemical Institute of Canada, 42nd Annual Conference, Halifax, Nova Scotia.

May 25-28. ASME Design Engineering Conference, Convention Hall, Philadelphia, Penna.

June 4. New York Rubber Group, Summer Outing.

June 5. Fort Wayne Rubber & Plastics Group, Summer Outing.

June 5. Quebec Rubber & Plastics Group, Golf Tournament.

June 6-7. Southern Rubber Group, Colonial Inn, St. Petersburg Beach, Fla.

June 9. Buffalo Rubber Group, Golf Outing, Lancaster Country Club.

June 9-12. Material Handling Institute Exposition, Public Auditorium, Cleveland, Ohio.

June 12-14. Rhode Island Rubber Group, Silver Anniversary Summer Outing, Hotel Belmont, West Harwich, Cape Cod, Mass.

June 14-18. ASME Semi-Annual Meeting, Chase and Park Plaza Hotels, St. Louis, Mo.

June 15-19. American Society of Engineering Education, Annual Meeting, Pittsburgh, Penna.

June 19. Akron Rubber Group, Summer Outing, Firestone Country Club, Akron, Ohio.

June 21-26. ASTM Annual Meeting, Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

June 26. Detroit Rubber and Plastics Group, Summer Outing, Western Golf and Country Club, Detroit, Mich.

June 26-28. Los Angeles Rubber Group, Summer Outing, Las Vegas, Nevada.

Aug. 4. New York Rubber Group, Golf Outing, Forsgate Country Club, Jamesburg, N. J.

Aug. 21. Philadelphia Rubber Group, Summer Outing.

Sept. 12. Connecticut Rubber Group, Summer Outing.

Sept. 13-18. American Chemical Society, 136th National Meeting, Atlantic City, N. J.

Sept. 24. Fort Wayne Rubber & Plastics Group.

Oct. 2. Detroit Rubber and Plastics Group, Fall Meeting, Detroit Leland Hotel, Detroit, Mich.

Oct. 2. Philadelphia Rubber Group, Technical Meeting, Poor Richard Club, Philadelphia, Penna.

Oct. 6. Los Angeles Rubber Group. Meeting sponsored by Plastic and Rubber Products Co., Biltmore Hotel, Los Angeles, Calif.

Oct. 13. Buffalo Rubber Group, Fall Meeting, Hotel Westbrook, Buffalo, N. Y.

Oct. 16. New York Rubber Group, Fall Meeting, Henry Hudson Hotel, New York, N. Y.

Oct. 19-21. Ninth Canadian High Polymer Forum, Guild Inn, Toronto, Ont., Canada.

Oct. 23. Akron Rubber Group, Sheraton Hotel, Akron, Ohio.

Nov. 3. Los Angeles Rubber Group, Biltmore Hotel, Los Angeles, Calif.

Nov. 5. Rhode Island Rubber Group, Fall Meeting, Pawtucket Country Club, Pawtucket, R. I.

Nov. 6. Connecticut Rubber Group, Sports Night.

Nov. 6. Philadelphia Rubber Group, Annual Dance.

Nov. 8-13. Joint International Meeting of Division of Rubber Chemistry, ACS; Committee D-11, ASTM, and Rubber and Plastics Division, ASME, Shoreham Hotel, Washington, D. C.

Dec. 3. Fort Wayne Rubber & Plastics Group.

Dec. 8. Buffalo Rubber Group, Xmas Party.

Dec. 11. Detroit Rubber and Plastics Group, Xmas Party, Hotel Statler, Detroit, Mich.

Dec. 11. Los Angeles Rubber Group, Xmas Party, Beverly Hilton Hotel, Beverly Hills, Calif.

Dec. 18. New York Rubber Group, Xmas Party.

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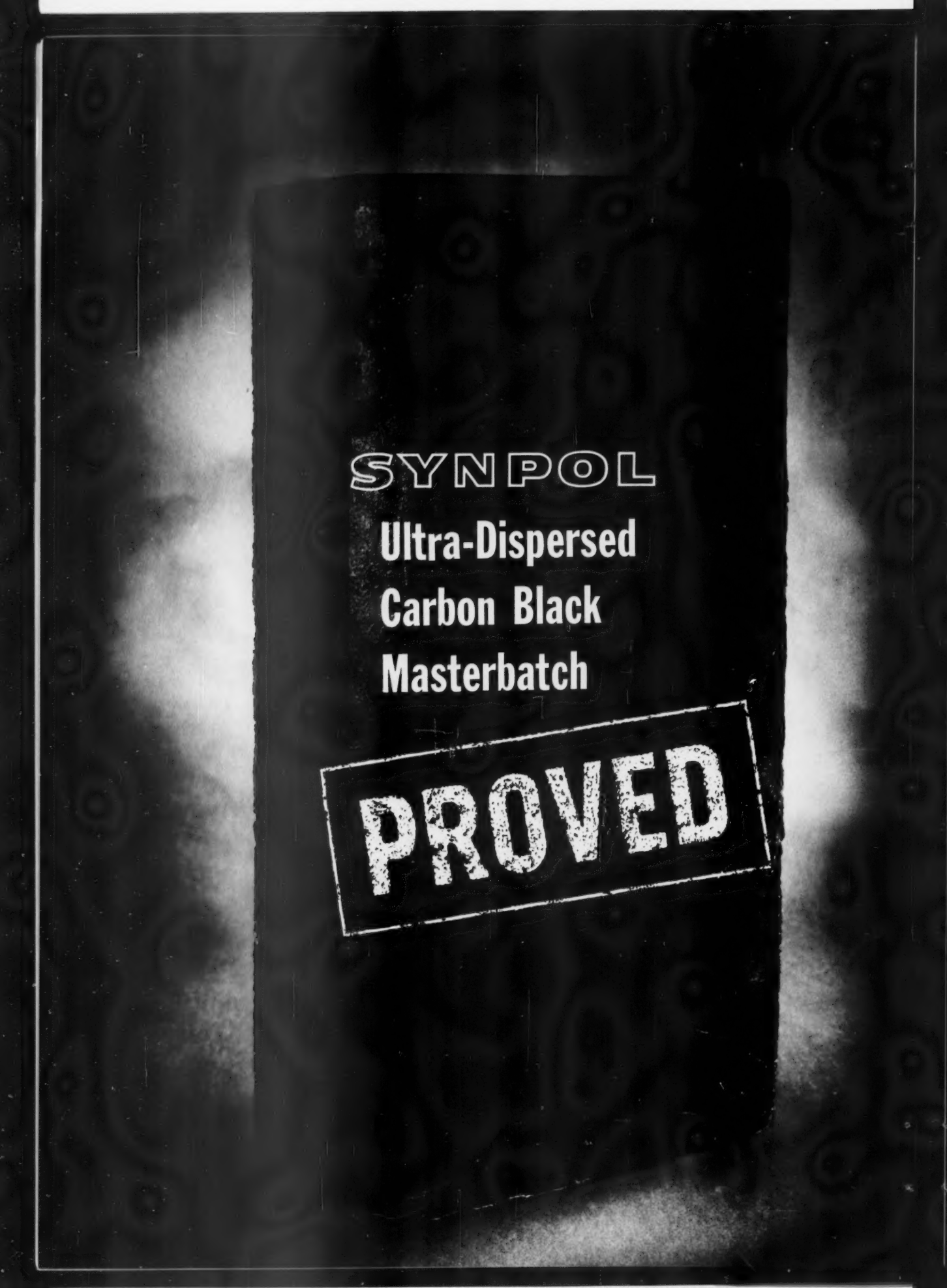
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capitol [illegible]

SIGNS OF A SLOWING IN BUSINESS RECOVERY have shown up during the last month or two. But economists don't believe this means that the upturn is petering out. They continue optimistic despite the fact that factory output is rising more slowly than last fall...employment shows little bounce... unemployment stays high...and new car sales have been slow to get rolling.

But the economy's strengths are thought to outweigh softness:

- Consumer incomes are rising, and people seem willing to buy.
- Retail sales got a lift with holiday business and have rolled on since. And car sales have begun to move fairly briskly.
- Inventory buying is quickening, as businessmen build stocks cut in the recession. This will give manufacturing a lift.

So Washington sees no need to revise its forecasts on steady growth in total business activity. The economy will expand 8% this year, to $470 billion. Personal income seems sure to rise $20 billion, to $374 billion. The biggest gain in the economy probably will come in corporate profits, which will jump some 30%, to around $47 billion—near the record.

EISENHOWER'S BUDGET WON'T SLOW BUSINESS very much. To be sure, it is an economy Budget, slashing spending by $4 billion for the coming year. And increases in expenditures were widely considered necessary for an upturn. But, Ike's Budget won't stay in balance. Congress will vote for more money. More importantly, there'll be jumps in things the government can't control—spending for farm price supports, debt interest, veterans' benefits, added money for the military. Net, federal spending is not likely to fall at all.

THE STATES WILL SPEND 9% MORE THIS YEAR, an added factor in offsetting cuts in U.S. outlays that Congress may allow to take effect. Those state legislatures that are meeting this year will vote some $3 billion in extra outlays, according to reports from the various capitals. This sum will be a substantial plus. The borrowing thus made necessary will add further lift.

TIGHTER MONEY AND HIGHER INTEREST RATES are coming in months ahead. In the past half-year, as recovery got rolling, rising sales brought in cash with no big jump in inventory or other outlays. So credit needs were light. But now demand for credit will go up as the pick-up quickens its pace.

Nearly every type of borrower will be wanting more credit in the near future. Businessmen must build up their inventory, and they'll need more for financing new capital investments. The Treasury needs new cash; home-builders will need a lot of credit for financing mortgages; and consumers will need credit for hard-goods purchases. Demand will outstrip new savings.

Monetary officials will be taking successive steps to tighten credit. For the time being, they are moving cautiously; they don't want to slow the recovery. A rise in the discount rate —which the banks must pay when they borrow from the Federal Reserve System—may be the first step in tightening. Interest rates will be rising and may go up a half percent this year.

capitol cues (cont'd)

DON'T BE MISLED BY THE STABLE PRICE INDEXES you will see in months ahead. They will mask some big price changes. On one hand, there will be large decreases in food costs, compared with last year when frost ruined crops and boosted prices. Offsetting these drops, on the other hand, will be increases in many manufactured goods and in rents, transit fares, and other services. The trouble is, the dips in food will be temporary while increases in other costs will probably come to stay permanently.

Some items which are likely to cost more this year:

- Liquor: Prices will rise 3-5%. A new law allows distillers to keep whiskey in bond longer without being taxed. Makers expect an end to dumping practices and resulting price wars.
- Oil products: Look for hikes of 2-3%. New Venezuelan taxes and wage increases in this country will boost crude prices.
- Metals: Wage costs will be rising. And reviving demand will allow nonferrous producers to recover some of the higher costs they absorbed in the recession. Aluminum will go up 2¢ to 3¢ a pound; copper, by 1¢; nickel, by 3¢; lead, by ½¢.
- Cotton: Bigger plantings may cut prices 3¢ to 4¢ per pound.
- New homes: Wages and materials costs are rising while house sites are getting scarcer and costlier. Net? Gains of 4-5%.
- Used cars: With used car buyers more numerous than new, the present upturn is boosting demand faster than trade-ins can meet it. Yet late models are few. So prices will be firm.

BIG GAINS IN PRODUCTIVITY NOW BEING REGISTERED will help keep prices of nonfarm items and services from going higher than forecast. New figures show that output per man-hour for workers in manufacturing went up by 6% last year; for all workers—including overhead—the gain was only 3%. The rises in 1958, centering in the second half, were about 50% greater than in 1957.

The continuing trend to automation and the shakeout of work forces in the recession were the prime reasons for the 1958 increases. Industry is discovering that it can turn out an expanding volume of goods with slightly augmented workforces.

THIS WILL BE A BIG YEAR FOR AMERICAN EXPORTS say government experts. Total merchandise shipments probably will go up around 8% during this year, to around $17.5 billion. Items that will benefit most will be grains, small appliances, industrial chemicals, machinery, and fabricated metals. Europe's purchases will increase the most, but solid gains are coming on shipments to Canada and Asian countries. U.S. imports will also be rising—around 10%.

CORPORATIONS WILL PAY BIGGER DIVIDENDS this year—perhaps 10% or 15%. This will more than reverse the downturn of some 2% that took place during 1958. Corporate profits will increase even more, around 30% to 35%, but the payout to stockholders will be held down in order to rebuild cash positions.

A CRACKDOWN ON DEDUCTIONS FOR BUSINESS EXPENSES is being waged this year by the Internal Revenue Service. The U.S. tax agents are launching another drive to halt expenses not "necessary" to the conduct of a business. This means they'll be tough on such deductions as those for football games, yachting trips, winter cruises, summer homes, etc. Businessmen will have to have plenty of evidence that such expenses are necessary in their businesses.

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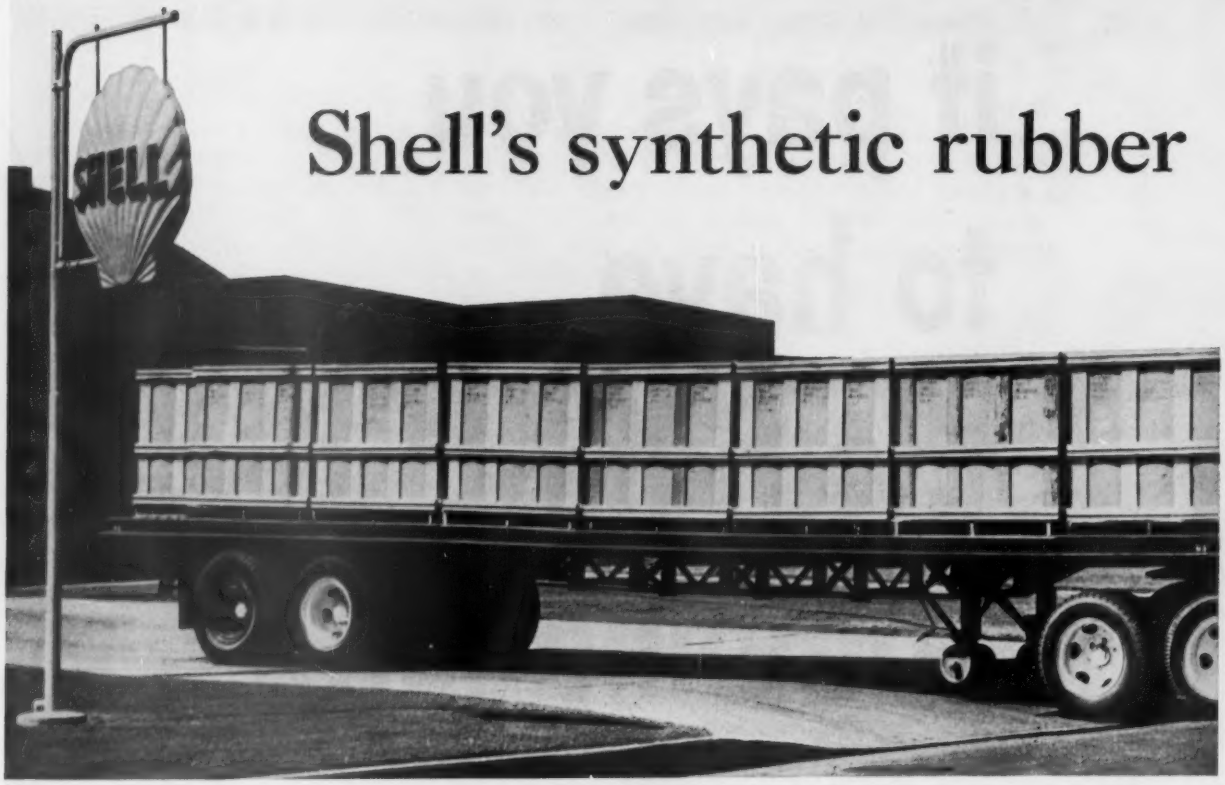

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MINIMIZE SHRINKAGE AND SWELL in extruded and calendered stock by addition of 10 to 50% of S-1009 (styrene-butadiene cross-linked with divinyl benzene).

S-1011

This unique polymer is GEL-FREE. Use it for superior ADHESION and SEALANT applications. It can also be used in light-colored goods because of its desirable color properties.

S-1013

If you're looking for high thermoplasticity . . . low water absorption . . . good flow characteristics, S-1013 may be your answer. Its uses include CAN-SEALING COMPOUNDS, COATED FABRICS, MOLDED GOODS.

S-1502

This polymer is the ALL-PURPOSE cold rubber. Light-colored, clear, its balance of physical properties makes it suitable for a variety of uses—from white sidewalls to chemically blown sponge.

S-1703

When you want ECONOMY with COLD RUBBER properties and processing advantages for use in light-colored goods, consider this OIL MASTERBATCH of 25 parts of nonstaining oil in 100 parts of polymer.

S-1804

You can reduce mixing time by using this oil black masterbatch in making TREAD RUBBER and MOLDED or EXTRUDED GOODS. It contains 10 parts of oil and 60 parts HAF black to each 100 parts of S-1500 type polymer.

S-2000

Here is an ECONOMICAL medium-solids hot latex with HIGH STYRENE content for better tensile and film strength. Use it for spreading and adhesive applications. Its small particle size aids penetration.

S-2105

FOR FOAM RUBBER and any other application which demands high strength and good color properties, this cold, high solids latex has found widespread acceptance.

S-2107

This HIGH SOLIDS COLD latex is identical with S-2105 except for its HIGH STYRENE content. It has excellent color characteristics and film strength and is used in upholstery and rug backing.

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SYNTHETIC RUBBER DIVISION
P. O. BOX 216, TORRANCE, CALIFORNIA

SHELL

HOW THE SILICONES MAN HELPED... BREATHE MORE LIFE INTO AN OXYGEN MASK

Aboard the new jetliners, oxygen masks are standard emergency equipment. If air pressure in the cabin drops, passengers and crew members can quickly breathe oxygen from a piped system.

Based on experiments by the military, manufacturers know that silicone rubber is the ideal material for oxygen face masks. It provides the thin, elastic shapes needed to fit all facial contours . . . with a gentle lubricity that feels pleasant to the skin. Since silicone rubber is highly resistant to oxidation, ozone attack and extremes of temperature, it can be stored for long periods and take repeated hot-water cleansing. *And*, any color is available—even "emergency" yellow.

This jet-age application demonstrates several useful properties of UNION CARBIDE silicone rubber. Background information and technical data available by writing Dept. BR-9901, Silicones Division, Union Carbide Corporation, 30 East 42nd St., New York 17, N.Y. *In Canada:* Bakelite Company, Division of Union Carbide Canada Limited, Toronto 7.

Unlocking the secrets of silicones

Rubber, Monomers, Resins, Oils and Emulsions

UNION CARBIDE SILICONES

The term "Union Carbide" is a registered trade-mark of UCC.

• R. S. Goy of the Dunlop Research Centre, in an address to a meeting of the Institution of the Rubber Industry at Newcastle, England, pointed out that difficulties of adhesion are the principal drawbacks to the use of synthetic fibers in the rubber industry. Although many of the new man-made fibers are superior to cotton because of their high strength and good heat resistance, they have their limitations.

In the case of tires, adhesion can be assisted by the use of chemical methods. One of these is the application of an aqueous solution of resorcinol formaldehyde resin and latex, the latex being either natural or one of the synthetic rubbers such as SBR or vinyl pyridene terpolymer. Another is isocyanate treatment, usually in the form of a solvent solution mixed with rubber. Belting and hose manufacture present a more intractable problem owing to the difficulty experienced in getting sufficient penetration and the long and expensive drying time required by the thicker fabrics employed.

• Plastic mixing machines amounting to about $320,000 have been ordered by Russia from the Morton Machine Co., Ltd., Scotland. The machines, ordered by Techmashimport, of Moscow, are mixers for plasticizing plastic powders such as PVC and PVA by the "dry powder method" or "dry blend". Each machine will handle 500 pounds of plasticized powder per hour and can discharge continuously into the feed hopper of an extruder, as it is fitted with twin barrels. The Russian order includes a number of pre-heated plasticizer containers for use with the mixers.

• International Finance Corp. has agreed to invest $225,000 in a Melbourne company, Rubbertex (Australia) Pty., for expansion of manufacturing operations. IFC's investment will be in dollar notes bearing interest at 6 per cent per annum, to mature between 1961 and 1970 and redeemable at any time. Rubbertex, which recently entered into a licensing agreement with the Lord Manufacturing Co., Erie, Penna., will also raise in Australia the equivalent of about $450,000, at least half of which will come from a public issue of stock.

• French tire manufacturers have announced that they have raised their prices by an average of 8 per cent to take into account the rise in raw rubber prices due to the devaluation, as well as to higher power and transport charges. The French Rubber Manufacturers Association has also announced that it has examined the impact of a number of tax measures on the price of rubber goods. This will mean additional price increases. Each manufacturer will now establish new prices as government price controls have been removed for rubber articles.

• U. S. Industrial Chemicals Co., a subsidiary of the National Distillers and Chemical Corp. of America, has entered into an agreement with an English firm, O & M Kleemann, for the sole representation and distribution in Great Britain of "Petrothene" polyethylene resins. Kleemann's subsidiary, Erinoid, will distribute resins and will also stock a wide range of the products of the U. S. Industrial Chemicals Co.

• American and Australian capital will finance a four-unit petrochemical plant in Australia, according to the Standard-Vacuum Oil Co., New York, N. Y. Representing more than $50 million of new industrial expansion for the Commonwealth, the project involves four separate units to be located near Melbourne. Among the end-products will be polyethylene, polystyrene and styrene rubber. Construction will start almost immediately and it is expected that the plant will be in production by mid-1961.

Standard-Vacuum's Australian affiliate, Vacuum Oil Co., Pty., Ltd., will build and operate the key unit, producing ethylene and butadiene from selected petroleum hydrocarbons processed at Stanvac's Altona refinery near Melbourne. The Australian affiliate of Union Carbide Corp. will build a polyethylene unit. Another chemicals company, still to be formed, will build a styrene producer. Both will be adjacent to Vacuum's petrochemicals unit.

Styrene and butadiene will be used to make styrene rubber in a fourth unit. Companies manufacturing tires in Australia will be invited to join in this unit. Australia will continue to import natural rubber from the rubber-growing areas.

• Imperial Chemical Industries, Ltd., has been granted a patent in which a polyester tetramethylene glycol or pentamethylene glycol and glutaric acid is reacted with a diisocyanate in more than an equimolecular amount, based on the polyester to form a synthetic resin. The polyester has an average molecular weight of at least 1000 and the reaction is carried out under substantially anhydrous conditions.

A rubber-like material is obtained by heating the synthetic resin in the presence of a basic catalyst or a crosslinking agent, or both. The basic catalyst may be the hydroxide of lithium, sodium, potassium, beryllium, magnesium, calcium or barium, or it may be an alkoxide or a tertiary organic amine. Suitable crosslinking agents include water, glycols, diamines, dicarboxylic acids, hydroxy-amines, hydroxy-carboxylic acids and amino-carboxylic acids.

The rubber-like materials have low rubber-glass transition temperatures; good mechanical properties;

On the Continent (cont'd)

low cold-hardening temperatures and low residual set after prolonged extension. Examples are given of the preparation of the synthetic resins and of the formation of rubber-like materials from them. Data are included for the rubber-glass transition point and the mechanical properties of the rubberlike materials.

• Phenix Works, Society Anon., Belgium, has received a patent in which an adhesive comprising a thermoplastic resin, dissolved in a solvent, is applied to sheet metal. The solvent is evaporated and the layer of adhesive heated to a temperature of 200 to 450°F. to render it soft and receptive to a film of plastic material which is to form a coating on the metal. While the adhesive is in this condition, a film of plastic material, heated to a temperature of 250 to 300°F., is fed under moderate tension to the softened adhesive layer on the metal sheet. The film of plastic material is progressively passed into intimate contact with the adhesive layer in such a manner that any air present between the film and the adhesive layer is expelled. The adhesive consists essentially of a mixture of a vinyl acetate-vinyl chloride copolymer modified with maleic anhydride; polybutyl methacrylate; and polyisobutyl methacrylate. The plastic material forming the film may be plasticized PVC.

• Farbenfabriken Bayer AG, Leverkusen, Germany has received the following patent: One or more of the following compounds, namely tetrachlorophthalic acid, hexachloroendomethylene tetrahydrophthalic acid and the anhydrides of these acids are esterified with a pentachlorophenyl, a tetrachlorophenyl or a trichlorophenyl monoglyceryl ether or an epoxide of one of these ethers to produce a polyester. Fire-resistant plastics are made by reacting a polyester produced by this process with a vinyl compound or a polyisocyanate.

As distinguished from the known polyesters prepared from tetrachlorophthalic acid as the sole chlorine-containing component, the polyesters made according to the invention do not adversely affect the properties of the plastics made from them, even when the polyesters contain the amount of chlorine required for making the final plastics fire-resistant.

• According to a patent granted to Lintafoam Industries, Ltd., latex foam rubber is provided with a surface coating of plastic by application of the plastic in liquid condition to the foam rubber, preferably after the foam rubber has gelled out, but before it has been vulcanized. Subsequent vulcanization of the foam rubber causes the plastic coating to be firmly held on the surface of the finished product. Suitable plastics for the coating include nylon, acrylic resins and vinyl resins.

• The Soviet Russian Industrial magazine, *Rubber and Resins*, has published the results of latest research efforts on methods of improving the physical-mechanical properties of vulcanizates of polysiloxane rubber SKT. Vulcanizates of polysiloxane rubber have good thermal and anti-freeze properties and good dielectric properties in wide temperature limits, but comparatively low stability, which limits their use in the cable industry. The physical and mechanical properties of these vulcanizates can be improved by using highly dispersed mineral fillers, with particle size in the order of a hundredths of a micron, the best varieties of silica filler giving tensile strength of 80 kg/cm² and elongation to 500 per cent. The thermal stability is improved by repeatedly processing the raw rubber mixtures on rollers.

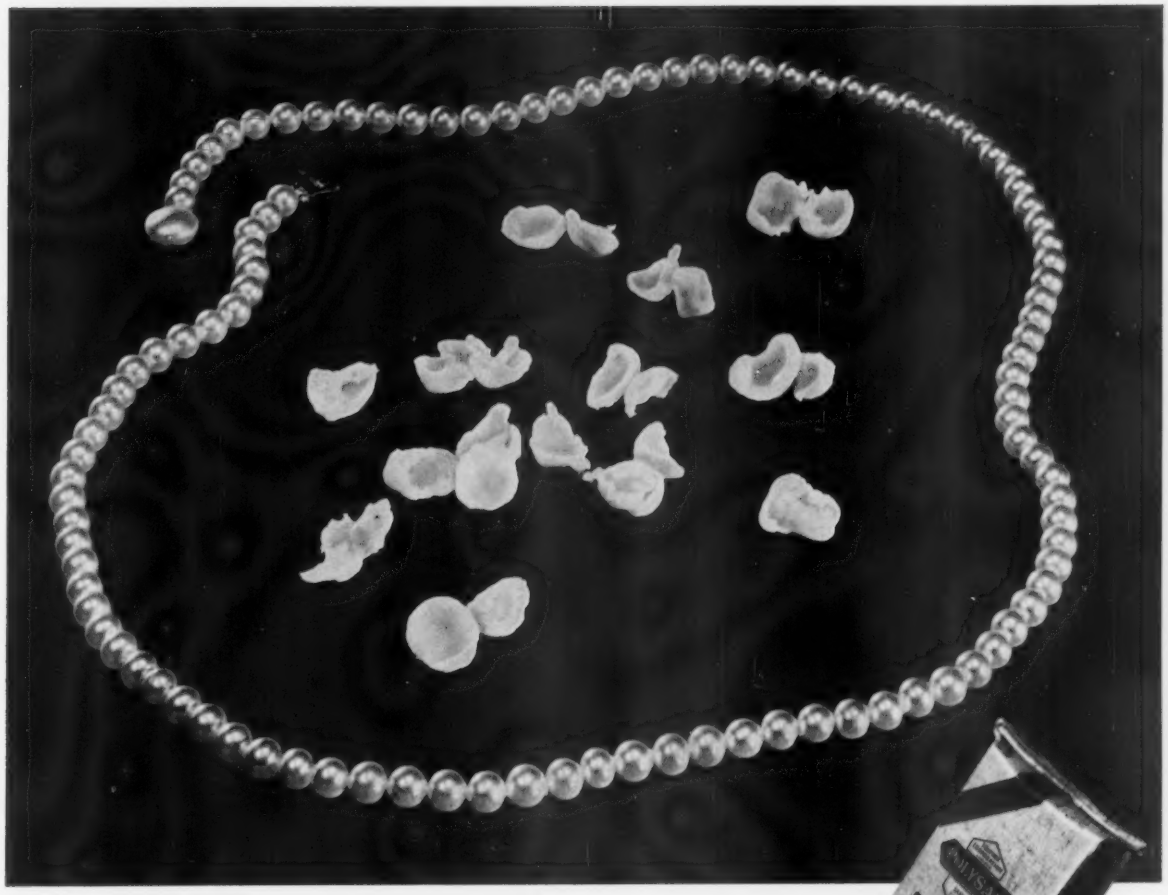
In practice, and as a result of this extra milling, optimum tensile strength is obtained when using 60 per cent of silica filler instead of the usual quantity of 50 per cent. Tensile strength of 50 to 60 kg/cm² and corresponding elongation of 275 per cent could be achieved. The rubber mixtures were prepared and tested in the laboratory, as well as on plant equipment. Test specimens of 1 to 2 millimeter thickness were vulcanized in two stages: in a press at 150°C. for 15 minutes; and in an autoclave at 200°C. for six hours. Various properties of the vulcanizates (tensile strength, elongation, thermal stability, electric properties, etc.) were tested according to standard methods. Titanium fillers were not found satisfactory because of variation in particle structure.

• Previous work on the polymerization of isoprene, dimethylbutadiene and other monomers under pressure have been reviewed in the Soviet Russian Journal *Rubber and Resins*. However, the chemical conversion of raw rubber under high pressure has not been described in literature. The author has now investigated this process as well as the influence of individual components of the rubber mixtures. The experiments were carried out on raw rubber and rubber mixtures at pressures varving from 3,000 to 10,000 kg/cm² (40,000 to 140,000 psi) and temperatures of 120°C. to 200°C.

The samples (cylinders with a 25 mm diameter and thin laminates, 50 mm diameter) were prepared in a 120-ton vulcanization press. Natural and synthetic rubbers were tested. Investigation of the structure of the conversion products of rubber SKB, prepared under high pressure, demonstrated the bonds in the rubber are opened and carbon-carbon links are formed. The outer double bonds disappear more quickly than the inner double bonds. The effective action of sulfur on the rubber SKB decreases considerably at increasing pressure. This may be due to the higher viscosity of SKB rubber under the influence of high pressure, which reduces the diffusion of the sulfur.

Further investigations concerned the influence of typical ingredients on the conversion of rubber mixtures under pressure. The action of various hardeners, fillers and plasticizers is compared, and the influence of antioxidants and benzoyl peroxide on the conversion of rubber SKB at high pressure, tabulated. If benzoyl peroxide is used, comparatively thick samples can be vulcanized within 1 to 3 minutes. The use of high pressure as a new method for obtaining molded rubber articles was also investigated.

Polysar **SS 250** FLAKE



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SBR compound with UOP antiozonant withstands ozone better than supposedly stable high-cost polymer— yet costs substantially less!

The rubber test strips shown above tell a story that's mighty important to your profit picture. In addition to the obvious superiority of one over the other is this significant fact:

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When you include UOP 88 or 288 in your formulation, the versatile chemical barrier slowly and uniformly migrates to vulnerable rubber surfaces—and thus keeps your product free of unsightly, degrading cracks throughout its entire life, regardless of the severity of conditions to which it may be subjected.

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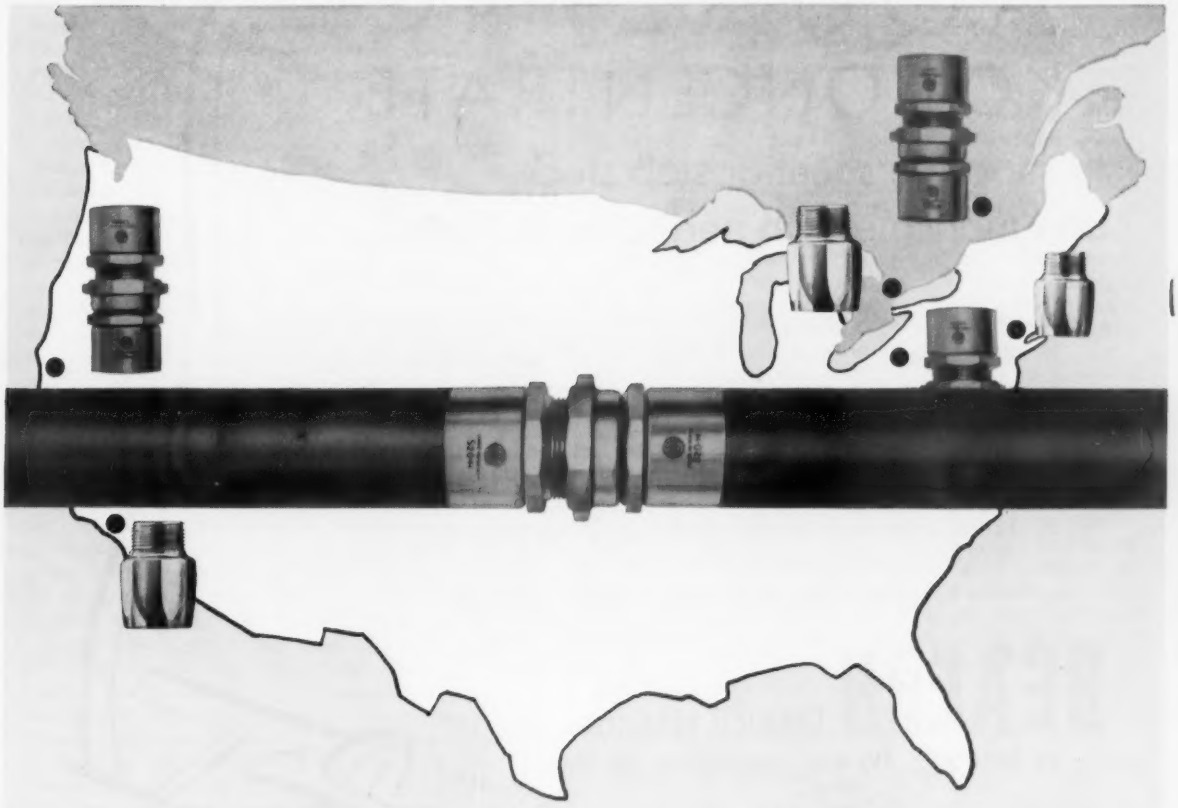

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As Soule Sees It...

Willie Hoppe

The death of Willie Hoppe, the fabulous "boy wonder" of three-cushion billiard fame, on February 1, pointed up the end of an era as well. In 1906, when Mr. Hoppe became world's champion at the age of 18, billiards was at its peak. An estimated 2 million people in this country were playing the game more or less regularly. Its popularity continued for 15 or 20 years, but has steadily declined and is now only a small town, ghostly image of its former self. What supplanted it and why the change took place are moot questions. Perhaps it would be fair to say that the public nowadays wants more action for its money and that bowling and golf fill that requirement better than billiards or pool.

Since Willie Hoppe was obviously a perfectionist, he took a keen interest in the tools of his trade. Besides the cues, balls and chalk, these included the rubber cushions which were built into the billiard table and against which the billiard balls struck and rebounded during the game. The all-important angle and speed of rebound were both greatly influenced by the rubber compound used in the cushion, the exact shape of the cushion, and the precise position in which it was mounted on the table. Although in use the cushion was entirely covered by a layer of green billiard cloth, the construction of the cushion itself was of vital importance. For instance, the cushion could be made with a layer of thin fabric embedded in its surface. The location of the fabric was very important. It could be placed in, over, above, or below the nose of the cushion. Each construction produced a difference in the rebound of the ball. It may be news that in big-league billiards, the ideal cushion was relatively "slow", but of course, true and constant in performance, while in pool, the snappier the rebound, the better.

In any case, a great deal of development work and consultation went into the production of a rubber cushion worthy of use in championship matches of the great Willie Hoppe and others. Many people collaborated in this work: Mr. Hoppe; some of the owners of the large billiard academies in New York City; the chemists and engineers who developed the rubber parts; and the salesmen who sponsored and followed through on the entire project. It was certainly a cooperative effort, but as I remember it, a large part of the credit for a good job well done should go to the dean of the old Manhattan Rubber Co., salesman Charles Kuhn. Mr. Kuhn, who is now 80 years old, has retired and lives in Merrick, L. I. He provided the spark and the drive which pushed the project to completion and gave great billiard players of that era a solid and true rubber background on which to build their amazing records.

Traveling Billboards

Although the primary purpose of the omnipresent postage stamp is to make possible the transportation of mail from one place to another, it has also developed a number of other functions. For better or for worse, it acts as a traveling billboard which carries its message not only to its own nationals, but to a large portion of the rest of the world as well. Thus it has become an international salesman and a silent "commercial" which cannot be turned out or denied admittance. It is hard to tell how effective such propaganda may be, but it is possible that the overseas impact of this class of United States broadcast may be an important adjunct to the "Voice of America."

Over the years, the continuing series of United States commemorative stamps has also served as a technicolor record of our country's history, its leaders in all fields, and its varied industrial life. As might be expected, the bulk of our stamps has been issued to mark anniversaries of important historical events. Thus, our first "commems," the Columbian issue, were put out in 1893 to celebrate the 400th anniversary of the discovery of America by Columbus. Many other similar issues have been printed in the ensuing years.

A great number of United States stamps have also been issued to honor specific industries and groups. Among these are the Poultry Industry, American Bankers Association, Railroad Engineers, American Chemical Society, American Automobile Association, American Society of Civil Engineers, American Bar Association, the trucking industry and many others. Stamps have been printed also to pay homage to individual leaders in all fields. The greatest outpouring of such stamps took place in 1940, when the "Famous Americans Issue" was released. In it were 35 separate stamps covering seven different classifications, including authors, poets, educators, scientists, composers, artists and inventors.

It is interesting to note that in spite of the torrent of stamps which have been issued in this country to honor all manner of deserving groups and individuals, no mention has been made of the rubber industry or of its most famous representative, Charles Goodyear. This was probably due to an oversight, and I suggest that officers of the Rubber Division consider the advisability of pushing the claims for portrayal of Charles Goodyear on a suitable commemorative stamp at an early date. Since the stamp program is laid out quite a number of months ahead, I suggest that an immediate start be made to try to arrange for the issuance of such a stamp in 1960, which is the 100th anniversary of Goodyear's death. This would give belated, but well deserved recognition to a basic industry and to one of its most brilliant scientists.

Shoes and Ships and Sealing Wax

The walrus in Lewis Carroll's classic, "Through the Looking Glass", got real mileage out of these three unrelated materials. Perhaps his heirs won't object if we make a 1958-59 study of the same three strange bedfellows.

Shoes: As we all know, production of rubber soles and heels has been an integral part of the shoe industry

As Soule Sees It (cont'd)

for many years. Soles and heels have been made in a variety of designs, constructions, colors and hardness and have been mass-produced in many rubber shops here and abroad. In fact, they have become such an accepted item that it is doubtful if very many people in the trade would have visualized the possibility of a successful innovation, much less a "sole-shaking cataclysm" in the standard items.

But, as *The Vanderbilt News* points out in a recent issue, the "Ripple Sole", manufactured exclusively in this country by the Beebe Rubber Co., has had a phenomenal production record since its introduction in 1955. In 1958, a poor year for many rubber products, the ripple almost turned into a tidal wave! Besides molding these special soles, Beebe also carries out development work on a molding unit which vulcanizes a complete sole and heel to a fabric or leather upper in a single operation. Uncured rubber stocks, for use by shoe manufacturers on these or similar vulcanizing units, are also fast-moving products of this concern.

The success story of this company seems to further illustrate the fact that modern day miracles are still in the making. When something which has been underfoot and kicked around for as long as the rubber sole can suddenly sprout wings and rocket into fantastic sales figures, it should give all bogged-down rubber departments a shot of hope and adrenalin. It would appear that the magic potion which sparked this phenomenon may have been compounded of equal parts of imagination, inventiveness, and "I can!" There is no patent on the combination. It is free for the taking, either for personal or corporate use.

Ships: The Boat Show, held at the New York Coliseum in late January, 1959, seems to have been an outstanding success, in terms of both the number and variety of craft displayed and the record-breaking crowds of people who attended the exhibition and bought freely of everything in sight. Unfortunately, I did not take in the show. My fear of contracting the virulent and contagious disease "Cabin Cruiseritis", from which I suffered for several seasons, kept me away. My comments can be based only on news and trade paper reports.

It appears that the big fact revealed by the boats displayed at the Coliseum is that the trend to fiberglass-resin construction, well underway in 1957, has been accelerated and expanded. At the 1957 show, 25 per cent of the craft displayed were of fiberglass, while this year, the figure was about 32 per cent. In each of these exhibits more boats of fiberglass were shown than of any other materials. This included plywood, aluminum or anything else.

This swing to glass fiber and resin construction has resulted in the consumption of large amounts of basic raw materials. It is reported that a total of 36,900,000 pounds of fiberglass, synthetic resins and fillers was used in boat manufacture during 1958. Although it is impossible to estimate the volume of other rubber and plastic items consumed in the construction or in outfitting these same boats, the poundage is obviously quite sizeable. Because glass and resin boats do not require the annual maintenance drudgery of scraping and painting, are practically indestructible and are competitive in cost with craft of plywood and aluminum construction, it is safe to predict that the present swing is sure to continue, in everything from small dinks to 40 footers and beyond.

One more item regard non-wooden boats: Press reports of January 11, 1959, state that an "all-plastic life-boat" has passed all of the rigid service tests of the United States Coast Guard and has, therefore, been approved by them. The boat was designed and built by the Lane Lifeboat and Davit Corp., Brooklyn, N. Y., which has been working since last July on a contract from the Maritime Administration for the development of plastic prototype lifeboats. The present boat is made entirely of fiberglass reinforced polyester resin, except for the release gear and some miscellaneous hardware and fittings. Since the Coast Guard is notoriously (and properly) fussy about its safety and performance standards, this approval certainly wont put any obstacles in the path of an even more rapid change-over to commercial fiberglass-resin boats.

If you aren't sea sick from too much "boating", there is another ship in the news, which deserves honorable mention. This is the combination balloon-sail boat known as "The Small World". As noted in the daily papers, its crew consisted of four Britons, three men and one woman. After traveling about 1800 miles through the air from the Canary Islands, they covered the remaining 1200 miles to the Barbados by using the gondola as a sail boat. The successful accomplishment of this 3000 mile air-sea voyage is a tribute to the navigational skill of the crew as well as to the design and construction of this hybrid vehicle.

The balloon proper was made of a fabric, of continuous filament Terylene (the United States equivalent is Dacron), weighing about two ounces per square yard; proofed both inside and out with neoprene; and with the seams bonded with the same material. The gondola, measuring 15 by 7½ feet, was made of expanded polystyrene, coated and reinforced with isocyanate-treated Terylene fabric. Terylene was also used for various rope lines, cordage, safety harness and sail cloth. The gas used to keep the balloon aloft was hydrogen.

Sealing Wax: This is really a specialty type adhesive, upon which I will have to do more research before I will be ready to comment. However, as they say in the TV court cases, "I reserve the right to testify on the subject later."

Attention All Private Eyes

Atlantic Research Corp., Alexandria, Va., has reported the development of a quick-drying plastic spray which is said to reproduce latent fingerprints more clearly and sharply than other methods now in use. In operation, the plastic is sprayed over a dusted print and the resulting film is stripped from the sprayed object. The film, which can be photographed or used directly as a transparency for showing on a screen, is stable and can be stored indefinitely.

A series of tests has shown that the new process gives more, and better detail than fingerprints made by the standard ink impression method. Tough on the crooks—now they'll have to be more careful to wear gloves when they go calling!

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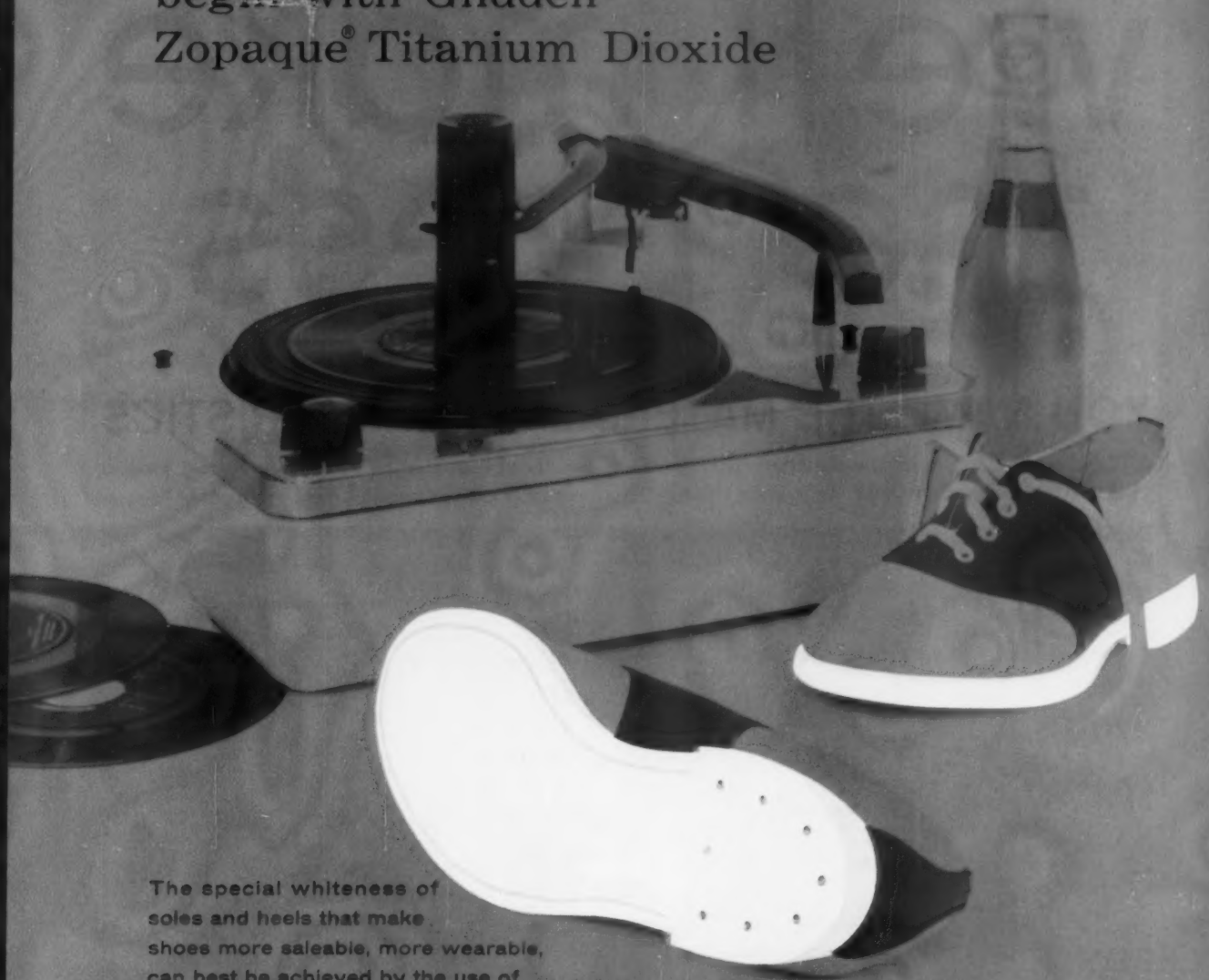

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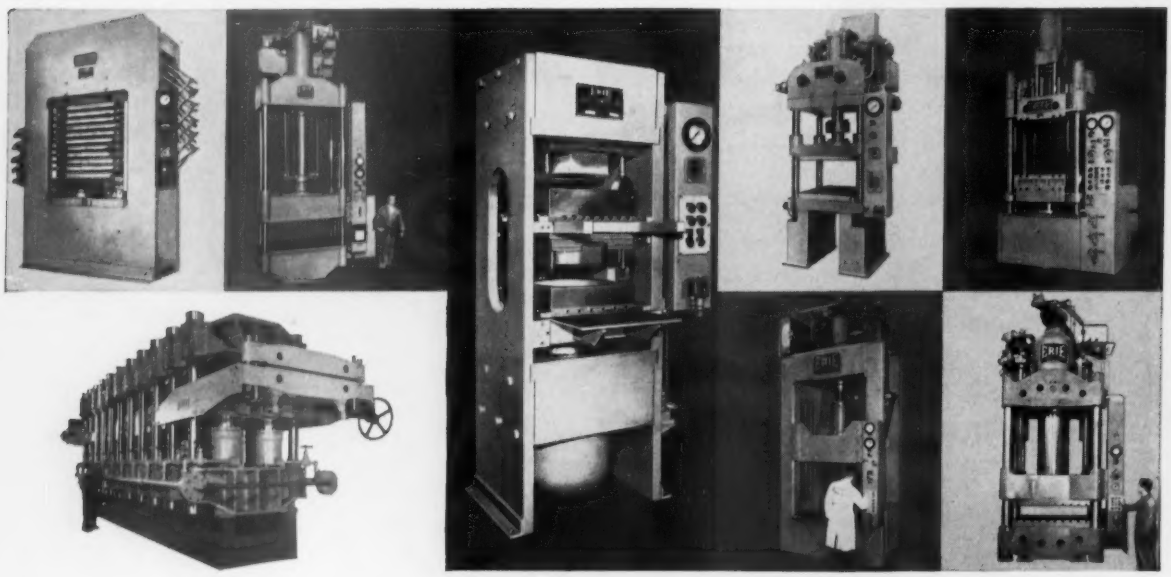

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A new method of

Identifying Carbon Blacks

A technique involving centrifugation and spectrophotometric measurements

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IN A previous work *(1)* reference was made to a study of the identification of carbon blacks by means of the determination of the "color index", that is to say, the ratio between the coefficients of optical absorption for wavelengths 430 and 750 nm, measured on aqueous dispersions with small quantities of gum arabic or in a 1% benzolic solution of first latex crepe rubber. It was also stated that such "color index"—within the limits of Lambert-Beer's Law—virtually remains constant for varying concentrations of the dispersions and therefore, for the purpose of classifying carbon blacks, is more significant than the value of absorption, since the latter depends on the concentration of the carbon black and on the degree of dispersion attained in the preparation of the samples.* Therefore this colorimetric index depends on the concentration of carbon black and consequently on its dispersion grade because it is based on differences of absorption values.

Relative methods of examination of carbon blacks, both in the free state as well as dispersed, in crude or vulcanized rubber compounds, were indicated, and their practical application outlined. Some of the limitations were also pointed out; these mainly consisted in the difficulty of recognizing individual blacks with very similar color indices and the impossibility of distinguishing the individual blacks in compounds containing one or more blacks with similar color indices, and of recognizing the compounds themselves.

With the object of overcoming these limitations, at least partially, a method has been evolved which has as its basis, in addition to the determination of the color index, the measurement of its variation due to centrifugation of the aqueous dispersions of the carbon black, and the measurement of the variation of concentration of the black in its dispersions, evaluated by means of the variation in value of the average optical absorption.

The most important and most difficult problem to overcome was the identification of blacks recovered from vulcanized compounds. The first step was therefore to examine the possibility of successfully utilizing the method for the recovery of carbon black already described. This method consisted in the disintegration of the compound, in quantities corresponding to one mg. of black, by means of heat treatment for two hours at 180°C. in the presence of paraffin oil. The black freed in this way was then dispersed between glass plates and the dispersion, diluted with a 1% benzolic solution of first latex crepe rubber, submitted to spectrophotometric measurements.

Although this method was quick and convenient, its disadvantage, especially for the coarsest blacks, lay in the effect of the coloring assumed during heat treatment by the paraffin oil and by the products of the demolition of the rubber and other organic ingredients. Furthermore, the presence of mineral fillers, white or colored, in the compounds, was also detrimental. These disadvantages would be even greater, if a gradual decrease in the concentrations of the free black were to occur during centrifugation. In addition, the

*In a recent work (2) the aqueous dispersions method has been taken again using sound vibrations and a dispersing agent for the preparation. Measurements of optical density were carried out by a filter photoelectro-colorimeter in blue, red and green light for the purpose of determining a colorimetric index K according to formula:

$$K = \frac{d_{blue} - d_{red}}{1 - d_{green}} \cdot 100$$

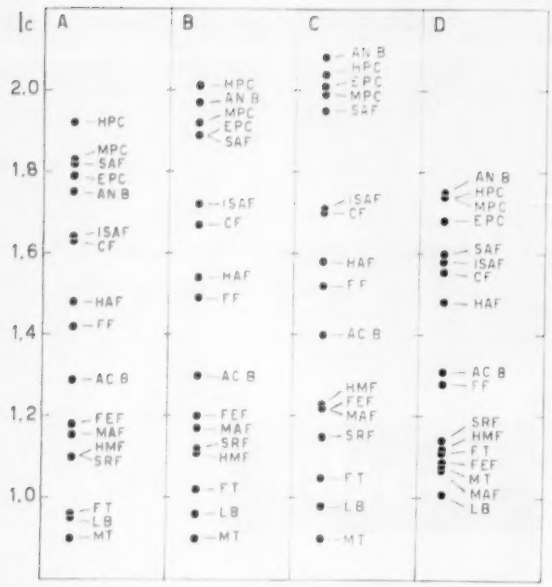


FIG. 1—Color indices of carbon blacks.
(A=free blacks; B=free blacks treated with nitric acid; C=blacks recovered from vulcanized compounds by means of nitric acid; D=blacks recovered from vulcanized compounds by means of paraffin oil.)

presence of a volatile solvent, simply by means of evaporation, could provoke a variation in concentration, and the presence of rubber could cause the formation of films which might immobilize part of the black.

In order to obviate these disadvantages as far as possible, it was decided to recover the carbon black contained in the compound in its purest possible state, and to proceed then with its dispersion in water and gum arabic, that is to say, using the method adopted for free carbon blacks.

Recovery of Carbon Blacks from Compounds

The well-known method of demolition of rubber by means of concentrated nitric acid, proposed by Parkinson *(3)*, seemed to meet the case, if suitably simplified. With this method only those mineral fillers which are insoluble in acids (silica, kaolins, barium sulfate, etc.) remain mixed in with the carbon black. All common types of rubber are destroyed, with the exception of butyl rubber; this rubber, as has already been described *(4)* must be attacked with tertiary butyl hydroperoxide before treating the recovered black with nitric acid. The methods tested are described below:

Method used for all natural and synthetic rubbers except butyl rubber. Between 50 and 100 mg. of compound (according to the carbon black content) are introduced into a test tube (capacity 7 cm^3) of an ultracentrifuge; one cm^3 of concentrated nitric acid (d = 1.40) is added and the test tube is then immersed in boiling water. After 15 minutes, a further three cm^3 of nitric acid are added and heating is continued for about six hours, the evaporated acid being replaced as necessary.

After cooling, the carbon black, freed from the rubber, is found deposited completely at the bottom of the test tube and the liquid becomes almost transparent. Centrifugal force is applied for five minutes at 4,000 rpm (approximately 10,000 m/s^2), the liquid is decanted and, still by means of centrifugation, washed first with water and then twice with ethyl alcohol at 95° (5 cm^3), and dried under vacuum for about three hours. One mg. of the black obtained is dispersed in water and gum arabic in accordance with the known method *(1)*.

Method used for butyl rubber. Ten grams of p-dichlorobenzol are introduced into a conical flask equipped with vertical condenser, and melted over a hot plate. One hundred mg of the compound are cut down and added to the mixture, which is allowed to boil gently for 30 minutes. It is then permitted to cool to 80 to 90°C. and 2.5 cm^3 of tertiary hydroperoxide and 0.5 cm^3 of a benzolic solution containing 0.08% osmium tetroxide, are added. The mixture is again boiled for 30 minutes, cooled, and 10 to 15 cm^3 of benzol added through the vertical condenser. It is then poured into a large crystalizer, and the benzol and p-dichlorobenzol are evaporated over a hot plate. The residue is collected and treated with nitric acid, by means of the previously outlined method.

Color Index of Recovered Blacks

The above described methods have been used in determining the color indices of the principal blacks recovered from vulcanized compounds, prepared in the laboratory on the basis of the following formula:

Rubber	100.00
Zinc Oxide	5.00
Sulfur	3.00
Diphenylguanidine	0.48
Benzothiazyl and dinitrophenyl sulfide	0.72
Carbon black	40.00

Cure: One hour at 143°C.

TABLE I—SYMBOLS OF CARBON BLACKS AND THEIR COLOR INDICES

		Color Indices			
Symbol	Type of black	Free blacks	Free blacks treated with nitric acid	Blacks recovered by means of nitric acid	Blacks recovered by means of paraffin oil
HPC	Hard processing channel	1.92	2.01	2.04	1.74
MPC	Medium processing channel	1.83	1.92	1.99	1.74
SAF	Super abrasion furnace	1.82	1.89	1.95	1.60
EPC	Easy processing channel	1.79	1.92	2.01	1.68
AN.B	Anthracene black	1.75	1.97	2.08	1.75
ISAF	Intermediate super abrasion furnace	1.64	1.72	1.76	1.58
CF	Conductive furnace	1.63	1.67	1.75	1.56
HAF	High abrasion furnace	1.48	1.54	1.58	1.48
FF	Fine furnace	1.42	1.49	1.52	1.28
AC.B	Acetylene black	1.29	1.30	1.40	1.31
HMF	High modulus furnace	1.10	1.11	1.23	1.12
FEF	Fast extruding furnace	1.18	1.20	1.22	1.09
MAF	Medium abrasion furnace	1.16	1.17	1.22	1.07
SRF	Semi-reinforcing furnace	1.10	1.12	1.15	1.14
LB	Lamp black	0.95	0.96	0.98	1.01
FT	Fine thermal	0.96	1.02	1.05	1.11
MT	Medium thermal	0.88	0.89	0.90	1.08

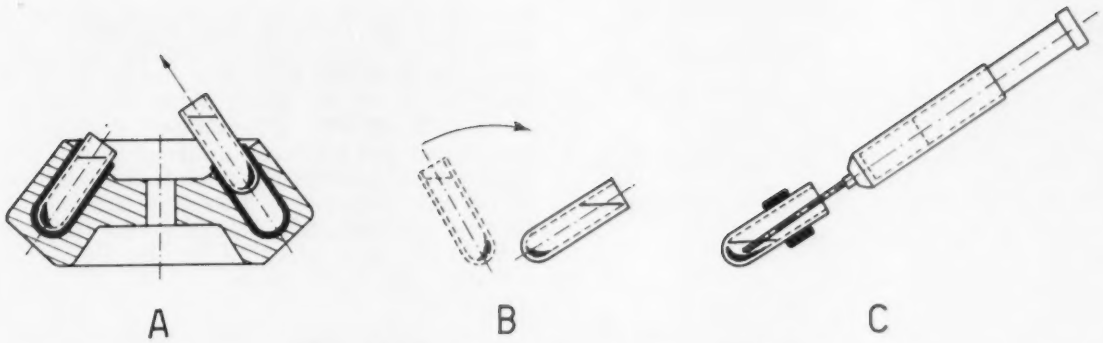


FIG. 2—Operations for the recovery of the centrifuged liquid.

The measurements of absorption for the two wave lengths .430 and 750 nm were taken with a Beckman DU spectrophotometer. The color indices are reported in Table I, which also indicates those, likewise measured on dispersions in water and gum arabic, of the free blacks and of the free blacks treated with concentrated nitric acid under the same conditions established for their recovery from vulcanized compounds.

An increase in the color indices is to be noted, especially for the finest blacks, after treatment with nitric acid; even more so after recovery by means of acid from the vulcanized compounds. Sufficient data are not yet available to explain this behavior with reasonable certainty. Among possible explanations, however, one assumption which should not be ignored is that nitric acid, in destroying the rubber, similarly destroys, at least in part, the substances extractable from the carbon black, and these substances almost surely either modify its optical behavior or affect its dispersibility in aqueous vehicles. This assumption is borne out by the fact that the greatest variation is obtained with blacks having a high benzenic extract.

Nor can the possibility that an even superficial attack on the granules of the black on the part of the nitric acid, with subsequent formation of humic or graphitic acid, might reduce the size of the black and vary its structure, be excluded. If this assumption is accepted, it can be admitted that the action of the acid is more keenly felt when the black has been previously dispersed in rubber, because this treatment may increase the subtraction of the extractable materials and intensify the attack on the black so that the coarsest blacks are less affected.

Table I also reports the color indices obtained by means of the previous method of disintegration with paraffin oil. A comparison between the latter values and those obtained by treatment with nitric acid will immediately reveal that in the first instance the distribution of the blacks is contained within closer limits (color indices between 1.01 and 1.75 instead of 0.90 and 2.08), and that some displacements occur in the scale of the blacks.

The scale of the blacks is illustrated by a graph (Figure 1) which permits the differences in their color indices to be seen with greater facility. There is an obvious advantage, therefore, as a greater spacing of values is obtained in carrying out the measurements on blacks treated with nitric acids rather than on free blacks. This advantage seems even greater when the relation is considered between the color indices (Ic) and the average absorptions between 430 and 750 nm (Am) (Figure 4) for eight of the principal blacks examined. It will be seen that excellent correlation exists between the two parameters and that the same degree of repeatability occurs only in the case of the treated blacks, while the values of the free blacks are not utilizable.

Centrifugation of Dispersions

Centrifugation was carried out on the same dispersions used for determining the color indices of the blacks recovered by means of nitric acid from the vulcanized compounds. To this series of individual blacks were added mixtures of MPC-HAF-SRF in varying proportions, as shown in Table II, which also gives the symbols adopted in the graphs.

A Terzano ultracentrifuge was used, with a rotating container fitted with six test tubes placed at a fixed slope of 45°, having a capacity of 7 cm^3, and a rotation speed of up to 18,000 rpm which, at an average radius of 5.5 cm, corresponds to approximately 20,000 m/s^2. Speed is indicated by means of an electric tachometer and regulated by controlling the tension applied to the motor. The area occupied by the rotating container is cooled by means of a thermo-regulated

TABLE II—SYMBOLS OF CARBON BLACK MIXTURES

Composition	Symbol
75% MPC + 25% HAF	m 3 h 1
50% MPC + 50% HAF	m 2 h 2
25% MPC + 75% HAF	m 1 h 3
75% HAF + 25% SRF	h 3 s 1
50% HAF + 50% SRF	h 2 s 2
25% HAF + 75% SRF	h 1 s 3
75% MPC + 25% SRF	m 3 s 1
50% MPC + 50% SRF	m 2 s 2
25% MPC + 75% SRF	m 1 s 3
33.3% MPC + 33.3% HAF + 33.3% SRF	m h s
66.6% HAF + 33.3% silica	h + sil.

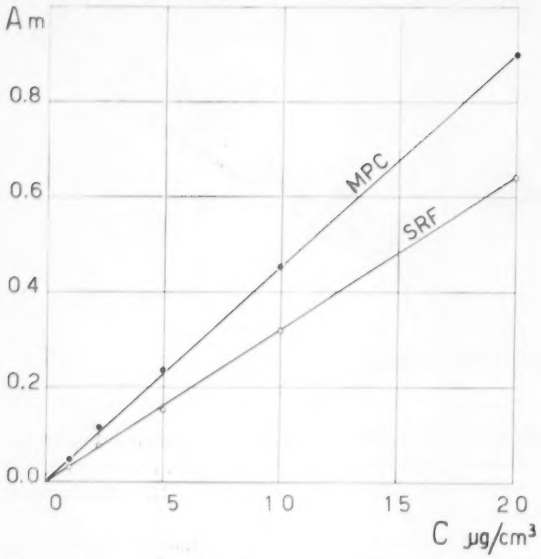


FIG. 3—Control of applicability of Lambert-Beer's Law in the case of carbon black dispersions.

refrigerating group and kept at a temperature of +5°C. throughout the centrifugations.

The recovery of the centrifuged liquid represents one of the most delicate operations in the entire test and it has been found that best results are obtained by following the methods outlined in this work. After the centrifuge has been stopped, the block containing the test tubes is extracted and placed onto a table. Care should be taken to avoid jolting. Each test tube is carefully extracted (Figure 2A), care again being taken not to rotate it, so that the contents will be shaken as little as possible.

The test tube is then turned very slowly without jerking (Figure 2B) so that the centrifuged product goes to the bottom, and fixed to the clamp of a support. A syringe is used to draw the liquid very slowly (Figure 2C), with the needle immersed for two or three mm. and following the variation of level. Special care is taken towards the end of the operation to avoid drawing the black deposited.

This operation, carefully carried out, allows nine-tenths of the volume of the initial liquid to be taken. Since the total volume is usually distributed over several test tubes, their liquid contents are then collected together and homogenized.

Measurements of absorption at 430 and 750 nm on the various centrifuged and non-centrifuged aliquots, are then taken. The ratio of the values relating to the two wavelengths will, as usual, give the color indices (Ic) of the dispersions before and after centrifuging. By calculating the average of these values, the average optical absorption (Am) is obtained which, according to Lambert-Beer's Law and to the fact that the absorption curves can in the case of the blacks be represented by a straight line, represents a value that can be considered proportional to the concentration.

The extensibility of the above law, in the case of very diluted dispersions of black, has already been utilized in previous research and checked even more recently on dispersions of black in mineral oil and in silicon oil *(5)*. As the validity of this law, however, is only applicable within a certain interval of concentrations, and since in this case the dispersions are of a highly variable concentration, it has been checked for the two most frequently used blacks (which are also the more representative in that they have values of high and low color index) for the intervals of concentration contained between 1 and 20 $\mu g/cm^3$ (Figure 3).

If color indices remain constant during centrifugation, then the optical evaluation of the concentration, based on the measurements of absorption, is exact. But as centrifugation proceeds, the color index moves towards higher values. However, once the relation between the color index and absorption for the initial concentration and for the various blacks has been found, and once the other curves have been plotted with equidistant abscissa (by the proportionality consequent to Lambert-Beer's Law) the weight values can be deduced from the absorption values, as a function of the color index (Figure 4). On the basis of this graph, a correction to the optical evaluation of the concentration can be made.

An example (Figure 5) graphically illustrates the increased distance between the values of the concentrations referred to the unit (C) found by photometric means, and those corrected by means of the above mentioned curves, in the case of the HAF black. Throughout the numerous checks made, this increased distance between values has always remained within limits equal to those of the inaccuracy of the method, and for this reason it was decided to forego this correction and consider the concentrations simply as proportional to the average absorption values.

Technique based on the centrifugation of separate aliquots of the dispersions. Ten cm^3 of each of the

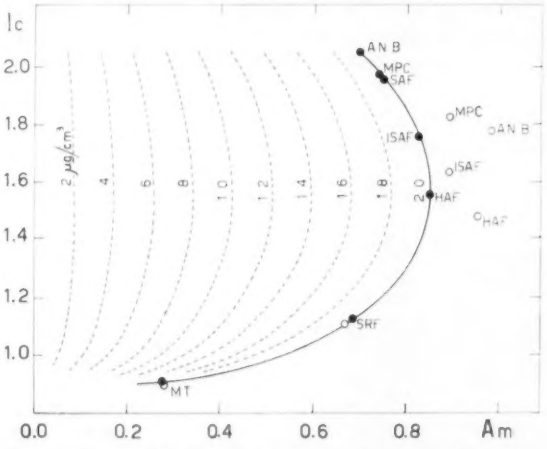


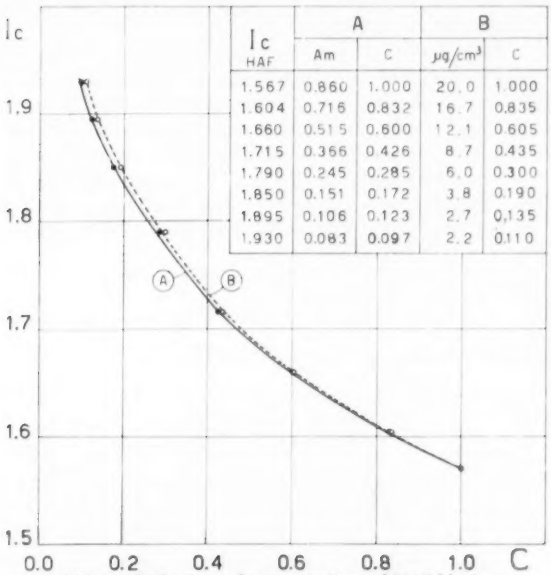
FIG. 4—Relation between color indices and average absorptions at various concentrations.
(Dot=blacks recovered from vulcanized compounds by nitric acid; Circle=free blacks.)

dispersions in water and gum arabic of the individual blacks (one mg. in 100 cm^3) are centrifuged for ten minutes at 4,000 rpm (approximately 10,000 m/s^2) and ten other cubic centimeters are centrifuged for ten minutes at 10,000 rpm (approximately 60,000 m/s^2).

The values of the color indices (Ic) and of the average absorptions (Am) obtained with the non-centrifuged dispersions and with the dispersions centrifuged at 4,000 rpm and at 10,000 rpm are illustrated in Figure 6, where they are plotted respectively on the ordinate and on the abscissa (the latter in a logarithmic scale). The lines on the graph are purely indicative and connect the values obtained with the dispersions (points to the right of the figure) with those centrifuged at 4,000 rpm (intermediate points), and with those centrifuged at 10,000 rpm (points to the left of the figure).

With regard to color indices, repeatibility was excellent with non-centrifuged dispersions and good with centrifuged dispersions, except for those blacks with lower characteristics. With these, on the other hand, greatest variation in concentration is had during centrifugation owing to the size of the granules. Repeatibility for Am values was, naturally, poorer, but in any case sufficient to give a fairly accurate indication of the variations of the concentrations for each individual black.

It should be noted that the effect of centrifugation, for the same time and speed, is greater on those blacks with a lower color index and that the broken lines which represent the mixtures usually have a different trend from those of the individual blacks. Nevertheless, blacks with average color indices can be distinguished with certainty from the mixtures having the same index only if the latter are made up of very different blacks, as for example, MPC and SRF.



Ic HAF	A		B	
	Am	C	µg/cm³	C
1.567	0.860	1.000	20.0	1.000
1.604	0.716	0.832	16.7	0.835
1.660	0.515	0.600	12.1	0.605
1.715	0.366	0.426	8.7	0.435
1.790	0.245	0.285	6.0	0.300
1.850	0.151	0.172	3.8	0.190
1.895	0.106	0.123	2.7	0.135
1.930	0.083	0.097	2.2	0.110

FIG. 5—Evaluations of concentrations of HAF black. (A=concentrations measured photometrically; B=concentrations measured by weight.)

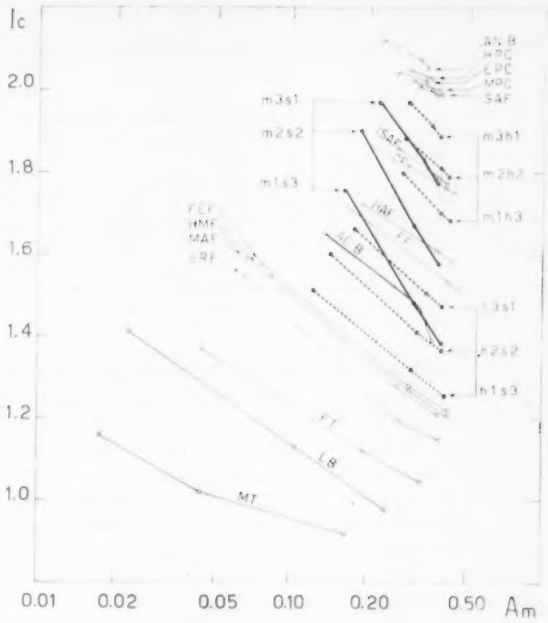


FIG. 6—Technique of centrifugation of separate aliquots of individual blacks and of mixtures (see Table II).

Technique based on successive centrifugations of a single aliquot of the dispersion. Although the technique previously outlined has, to some degree, contributed towards the solution of the problem of the identification of blacks and their mixtures, a centrifugation technique has also been studied which allows this method to be exploited in the most rational way so that the test still retains its practicality and ease of handling.

For these tests, eight of the same samples of black extracted from vulcanized rubber compounds, as were used in previous experiments, were employed; that is to say, the number of types examined was limited and the most typical selected for each type. In addition, the binary and ternary mixtures indicated in Table II, with the exception of those mixtures containing MPC and SRF blacks, were also examined. The mixture containing silica was examined to check the effect due to the presence of silica fillers insoluble in acids. Some samples from diverse sources of MPC and SAF blacks (whose characteristics are very similar) were also examined to check whether the inevitable differences in the same type could have any effect on the possibilities of recognition.

All mixtures were prepared by mixing, in suitable volumetric proportions, the dispersions of the individual components. Two tests were carried out on each type, beginning with the weighing of the blacks, whose initial concentration was double compared with the previous technique (one mg. in every 50 cm^3), in order to measure with greater accuracy the values of absorption of those dispersions having a very high degree of centrifugation.

TABLE III—TECHNIQUE OF SUCCESSIVE CENTRIFUGATIONS

Initial color index	Speed of centrifuge (rpm in thousands) — Phases							
	0	1	2	3	4	5	6	7
≈ 0.9 ÷ 1.0	0	4.4	4.4	4.4				
≈ 1.0 ÷ 1.4	0	4.4	4.4	6.0	6	6	6	
≈ 1.4 ÷ 1.8	0	6.0	8.0	10.0	12	14	16	16
≈ 1.8 ÷ 2.1	0	8.0	10.0	12.0	14	16	16	16

With the previous technique, two separate samples of each dispersion were subjected to centrifugation (at 4,000 and at 10,000 rpm) and, together with the non-centrifuged dispersions, were subjected to spectrophotometric readings; therefore, each curve was defined by only three points. All types of black, furthermore, were subjected to the same treatment and consequently for the finer blacks the fraction separated at maximum speed was 20%, whereas it exceeded 90% for the coarser blacks.

As it has been verified that a centrifugation curve in order to be significant must extend at least to 60% of the precipitated substance, while it is superfluous to exceed 80%, and that for comparative purposes it is sufficient to plot the curves with six or seven experimental points distributed within these limits, a technique has been adopted which satisfies all these requirements. This technique is based on the centrifugation, in successive phases, of the same aliquot of dispersion.

Centrifugation and photometric readings. A dispersion of 50 cm³ is prepared with one mg. of black by the usual method between glass plates in an aqueous vehicle, and the optical absorption measured at 430 and 750 nm. After the dispersion is measured, it is recovered and added to the remainder, the whole being centrifuged in two lots. The liquid is distributed over six test tubes, until the entire volume has been utilized. It is then collected and homogenized by the usual method previously outlined (about 45 cm³ are obtained) and spectrophotometric measurements again taken.

Again the liquid is collected, as outlined above, and subjected to a second phase of centrifugation, at the same speed or at a greater speed according to the type of black, the same technique being used as for the first phase. Readings are again taken, and the third phase begins. And so on. This continues as long as there is sufficient dispersion available, or as long as the Am values are reduced to less than 20% of the initial values.

The time fixed for each phase of centrifugation is four minutes and the predetermined speed of operation is reached within 30 seconds by carefully regulating the speed. After four minutes of constant speed, the centrifuge is stopped by removing power from the motor. The centrifuge is allowed to halt spontaneously without any braking.

Timing and speed of centrifugation can be varied at will, but in order to insure that the program is completed with 50 cm³ of dispersion and that the same number of points for each curve are obtained with suitable frequency, it is advisable to follow the procedure reported in Table III. From this, on the basis of the initial color index of the black, the most suitable program can be determined.

Results and Discussion

This centrifugation technique differs from the previous one in that it takes into account not only the variations of the color index and average optical absorption during centrifugation, but also the forces used to obtain these variations. In fact, the centrifugal force applied in each phase is proportionate to the square of the speed, and consequently, provided the rotation radius remains approximately the same, is also proportionate to the square of the number of revolutions. Leaving aside the forces acting during acceleration and slowing down, if the timing of each phase is constant, the average force in a cycle of a given number of phases can be proportionately represented by the sum of the squares of the number of revolutions in each phase.

Thus, knowing the average absorption which, as already outlined, can represent the concentration of the dispersion, one can calculate the quantity of solid substance separated in each single phase and the total quantity separated in a given number of phases by simple difference from the unit of concentration. If the ratio between the solid substances separated and the relative average centrifugal force applied is taken,

TABLE IV—VALUES FROM SUCCESSIVE CENTRIFUGATIONS OF ANTHRACENE BLACK

1	2	3	4	5	6	7	8	9	10
			A 430	A 750					
N	N'	Σ	n m	n m	Am	Ic	C	Cp	Cp/Σ
0	0	0.000	0.941	0.459	0.700	2.050	1.000	0.000	—
8	64	0.064	0.733	0.350	0.541	2.095	0.773	0.227	3.54
10	100	0.164	0.590	0.278	0.434	2.120	0.670	0.380	2.32
12	144	0.308	0.448	0.210	0.329	2.137	0.470	0.530	1.72
14	196	0.504	0.305	0.140	0.228	2.180	0.317	0.683	1.35
16	256	0.760	0.210	0.095	0.152	2.222	0.217	0.783	1.03

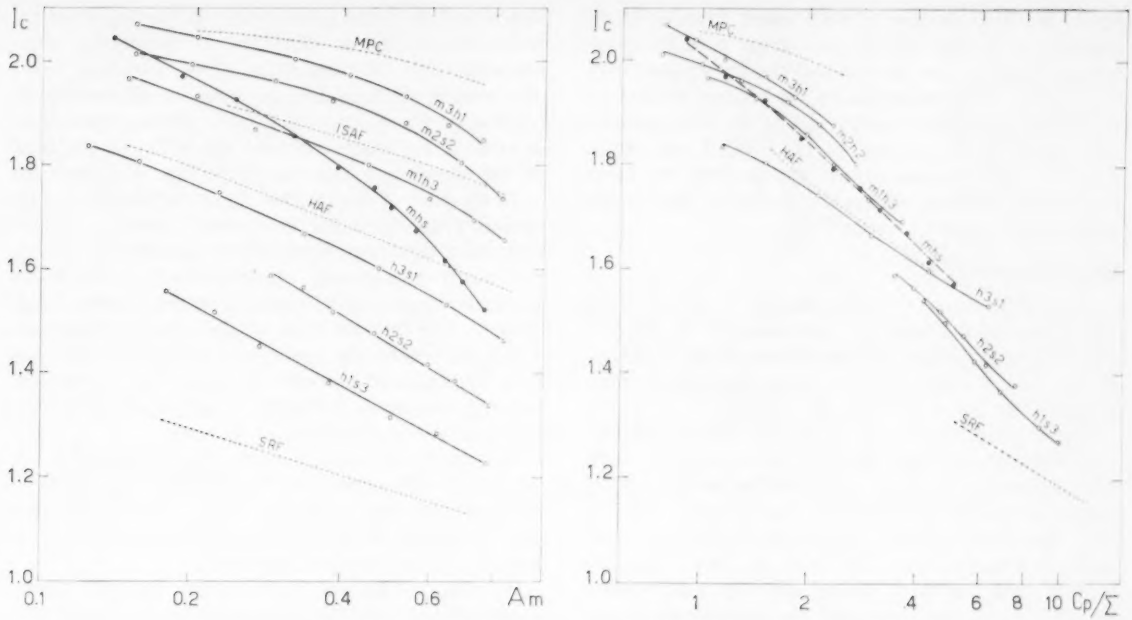


FIG. 7—Technique of successive centrifugations of mixtures of carbon blacks.

a value is obtained which takes into account the variations of both and which is of considerable utility for classifying the black.

Table IV reports in detail all values obtained for anthracene black only. The symbols used are the following:

Col. 1 — N — thousands of revolutions per min. of the centrifuge,

Col. 2 — N^2 — squares of the above (proportional to the centrifugal force applied to each individual phase),

Col. 3 — Σ — sum of the values on N^2 (proportional to the total centrifugal force applied from the start),

Col. 4, 5 — A — spectrophotometric readings (absorption),

Col. 6 — Am — average absorption values $\left(\frac{A\ 430 + A\ 750}{2}\right)$

Col. 7 — Ic — color index $\left(\frac{A\ 430}{A\ 750}\right)$

Col. 8 — Cp — relative quantity of substance deposited, obtained by difference from unit of concentration $\left(Cp = \frac{Am_o - Am}{Am_o}\right)$ and

Col. 9 — $\frac{Cp}{\Sigma}$ — index directly proportional to the percentage of black precipitated and inversely proportional to the centrifugal force applied.

As the most significant parameters are three, two different methods of representation have been adopted. With the first method of representation, already used for the centrifugation of separate aliquots previously outlined, the color indices are plotted on the ordinate and the average optical absorptions on the abscissa (in a logarithmic scale), so that the curves represent the variation in color index (selective effect of centrifugation) as a function of the variation in concentration.

With the second method of representation, the color indices, still plotted on the ordinate, are instead expressed as a function of the logarithm of the ratio $\frac{Cp}{\Sigma}$ (in a logarithmic scale), so that the centrifugal force is taken into account.

With both the above outlined methods of representation, the first thing to note is that the slope of the curve of the mixtures (Figure 7) is steeper than that of the individual blacks (Figure 8), and the more complex the mixture the steeper the slope. This is logical insofar as the slope of the curve depends on the variation of the color index, due to the variation of the granular distribution of the black still dispersed. This would not occur in the case of a hypothetical black consisting of perfectly homogeneous granules, whose curve would be expressed as a straight line parallel to the axis of the abscissa.

The usefulness of the second method of representation is brought out when MPC and SAF carbon blacks are examined, for with the first method their curves are coincident and with the second their curves are separate.

Although there is some dispersion of values due to the variability between batches and suppliers—thus the two types of black are represented by two wide strips—the efficacy of this graphic method of representation is nonetheless confirmed (Figure 9). In fact, the values obtained from five samples of MPC

black and five samples of SAF black from different suppliers, are contained in two strips partially overlapping with the first method and clearly separate with the second. The usefulness of the second method of representation is also brought out by the examinations undertaken of the mixture of HAF black and silica, which is virtually non-distinguishable from the black by the first method, whereas it is clearly distinguishable by the second (Figure 9).

Optical Phenomena

As will be noted, the color indices of the principal free blacks of the various types indicated in the previous work *(1)* differ somewhat from those indicated in the present work. The following explanatory comment will be found useful in this respect.

The experimental work undertaken for the identification of carbon blacks, outlined in the previous work, was carried out by means of two different spectrophotometers: Pulfrich's photometer and Sigrist's photometer. The former is well known and its characteristics need no introduction. The latter, oí Swiss manufacture, is automatic with double rays, fitted with filters and a monochromotor for the visible spectrum, based on the optical zero principle. If both the spectrophotometers are used with filters (width of bands of wavelengths approximately 35 to 40 nm), they are fundamentally the same. If a monochromotor is used, the width of the bands is approximately six nm. The experimental work outlined here was carried out with a DU Beckman spectrophotometer, the characteristics of which need no explanation.

In the case of measurements taken on proper solutions, that is, in the case of molecular absorptions, apart from the accuracy and reproducibility of the readings which increases considerably in passing from the first to the second or third type of photometer, there are also other characteristics whose variation has a determining effect, in different ways for different wavelengths, on the absorption values. Among these characteristics, the main ones are the width of the band of the wavelength and the percentage of stray light.

In the case of dispersions of the carbon blacks, the optical phenomena are even more complex, in that their color does not originate from a molecular absorption but from a number of physical effects due to the particular degree of subdivision of the dispersed substance. The interpretation of the optical phenomena which determine the absorption of light on the part of a dispersion of particles in a polydispersed system, involves enormous difficulties which have always led to the adoption of empirical methods.

An interesting interpretation was attempted by A. Voet *(5)*, who considers the problem specially from the point of view of loss of energy due to diffusion, and attributes the divergence between theory and results to the presence of aggregates.

It can be affirmed that in preparing the method described here it is the aggregates which warrant greatest attention if significant and repeatable results are to be obtained. In fact, the size of these aggregates is such as to induce a phenomenon of interception of the light, similar to that obtained with the larger particles in monodispersed systems, and this phenomenon is superimposed on, and is in contrast to the diffusion of the light. This can be seen on examination of the curve in Figure 4.

From this graph, which shows the absorption as a function of the color index, it can be seen that, beginning with the blacks having larger particles, the inter-

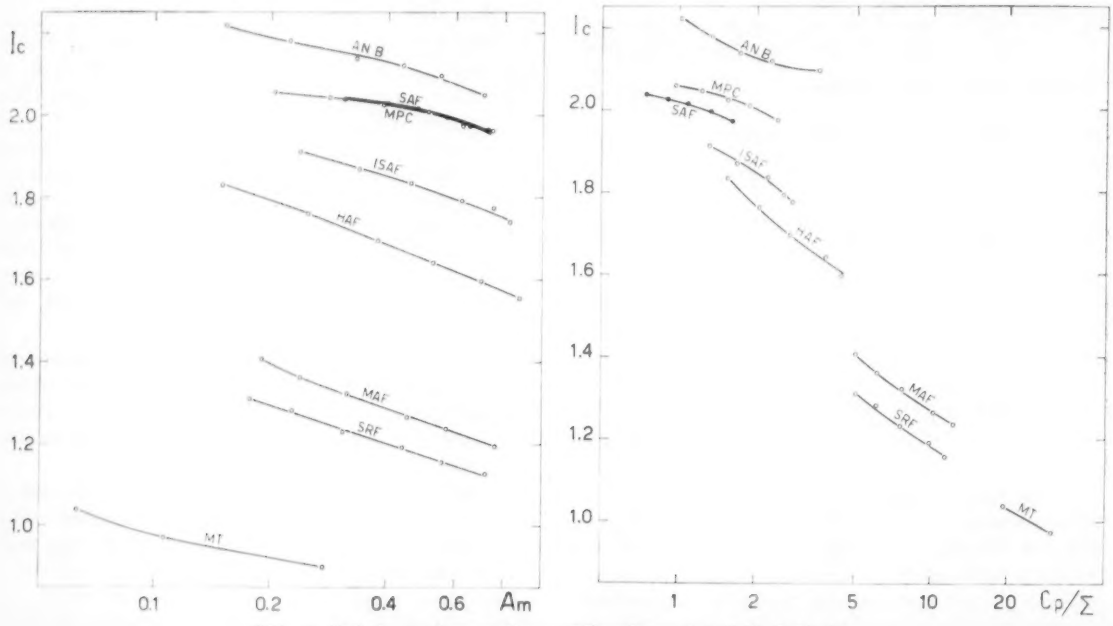


FIG. 8—Technique of successive centrifugations of individual blacks.

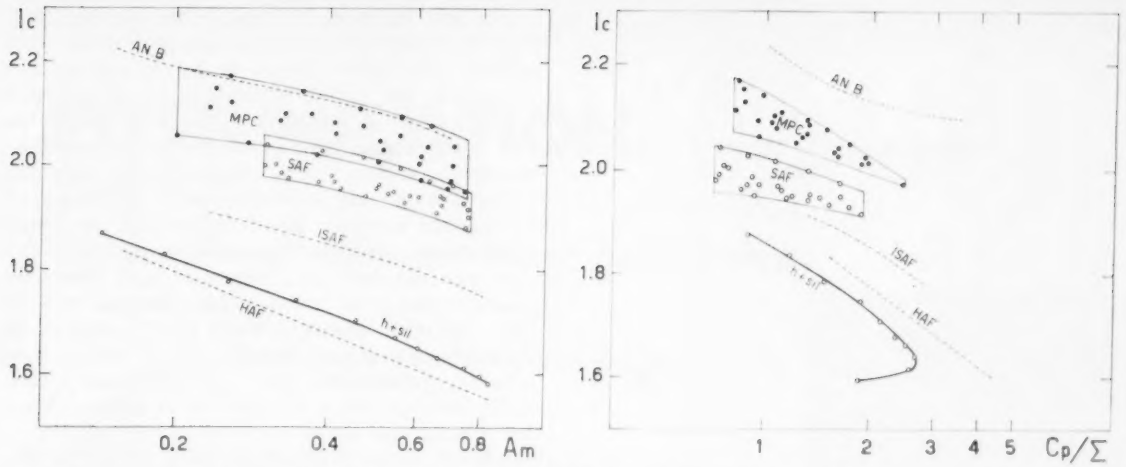


FIG. 9—Technique of successive centrifugations of MPC and SAF blacks from different suppliers and batches and mixtures of HAF black and silica.

ception phenomenon determines a greater absorption value which increases as the diameter of the particles decreases, and is justified by the increase of the intercepting surface, up to the HAF black. Over this limit the interception phenomenon rapidly decreases and allows the diffusion phenomenon to prevail, which, because of its contrasting trend, determines a retrocession of the values.

Leaving aside secondary phenomena, such as the preferential angle and degree of polarization of the transmitted light compared with that of the incident light, and such as those due to multiple reflections among the aggregates, it is clearly seen that the results cannot be interpreted solely on the basis of the laws of diffusion, and that the measurement alone of the latter or of the absorption are not sufficient for identification purposes—hence, determination of the color index is also necessary. Since the value of the color index assumes greater significance as the interception phenomenon due to the aggregates becomes more limited, the sensitivity and repeatability of the results are strictly bound and determined by the technique of preparation.

Dispersion between glass plates in an aqueous vehicle was therefore adopted, for this method was deemed sufficiently energetic to destroy pre-existent aggregates and thus create the conditions necessary for a spontaneous reconstitution of the aggregates, according to the law of flocculation.

It was believed that this method offered greater scope for obtaining reduced and more characteristic dimensions than those obtainable with the far less energetic action of a mill. The action of a mechanically operated mill, especially in the presence of an oily and viscous vehicle which is in any case necessary for rotation of the two frosted glass surfaces, does not allow sufficiently close contact between the two surfaces during rotation, and consequently the speed gradients necessary for breaking down the agglomerates pre-existent in the black, are less easily attained.

The range of color indices for free rubber carbon blacks obtainable from absorption values at 430 and 750 nm deduced from the curves of the work previously mentioned *(5)* where dispersions are prepared by means of a Hoover mill, is far more limited than the range obtainable by dispersion between glass plates in an aqueous vehicle, that is, between 0.89 for SRF black and 1.07 for EPC black instead of between 1.10 and 1.92. In fact, if the carbon blacks used for rubber compounds alone are considered, it will be seen that even the n values obtainable by the relation binding the absorptions to the wavelengths on a logarithmic scale ($\log A = B_0 - n \log \lambda$) which also represent the slope of the lines, are much closer, as are the color indices obtainable from the relative absorption values around the unit.

To prove the foregoing, an experiment was carried out by dispersing an EPC type black in mineral oil by means of a Hoover mill and also between glass plates. As expected, not only was the color index obtained by mechanical dispersion (1.08) considerably lower than the color index obtained by manual dispersion between glass plates (1.48), but it was also far inferior to that obtainable in an aqueous vehicle (1.92).

Ultraviolet Tests

Voet's work not only reports examinations made in connection with the visible spectrum and near-infrared rays, but also indicates the results obtained on examination of dispersions of carbon black in mineral oil and silicon oil in the ultraviolet. Absorption curves are shown which appear very similar for the different types of black and which show pronounced maximum and minimum points in the interval contained between 2100Å and 2840Å, while they do not show these points for wavelengths longer than the latter, which is defined as the rotation point between the wavelengths and the absorptions.

On completion of the present work, ultraviolet spectra of dispersions in mineral oil and silicon oil of

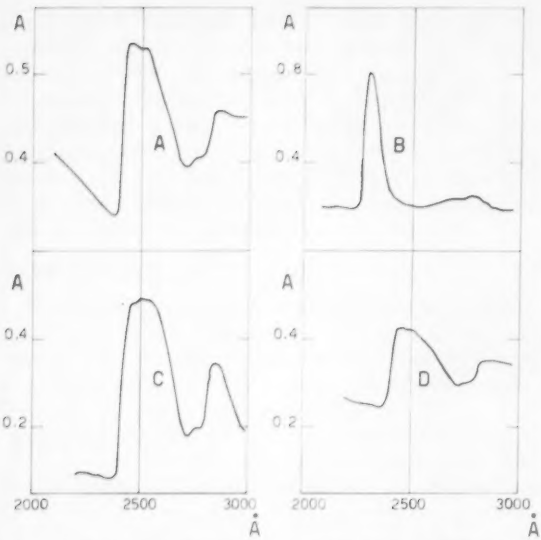


FIG. 10—Absorption spectra in ultraviolet range of EPC black. (A=black dispersed in mineral oil; B= black dispersed in silicon oil; C=benzenic extract dissolved in mineral oil; D=black recovered from vulcanized compounds and dispersed in mineral oil.)

EPC black were also examined, and the same type of curve (Figures 10A and 10B) obtained. The great similarity between these curves for the various carbon blacks led to the assumption that they might not be due to the black but to the extractable substances it contains. A Soxhlet extraction of the black was therefore carried out in benzene, and the extracted substance dried under vacuum and dissolved in mineral oil; the ultra violet spectrum, between 2350 Å and 2840 Å, of this perfectly transparent solution, was identical with that of the dispersion of the same black. The above hypothesis was thus confirmed (Figure 10C).

The dispersion of carbon black recovered from the vulcanized compound by means of nitric acids showed the same spectrum but with absorption values reduced by one-fifth (Figure 10D), which signifies that it is not possible to destroy completely the "non-black" substances.

The spectrum of a dispersion of the same type of black in water and gum arabic is not formed of sharply defined maxima and minima but of slightly rising curves. This again confirms the assumption that extractable substances, not being soluble in water, cannot have an ultraviolet spectrum.

Conclusions

The study of the effect of centrifugation on dilute suspensions of carbon blacks, in relation to the variation of the color index and average optical absorption, has made available a considerably more efficacious method of identifying carbon blacks than that formerly used, which comprised merely measuring the color index in order to identify blacks with almost identical behavior and to distinguish mixtures from individual carbon blacks with similar color indices.

The first technique outlined, based on the centrifugation of separate aliquots of the dispersions, while offering considerable scope, is not as rational and accurate as the second, which is based on successive centrifugations of a single aliquot of the dispersion. The latter method, in fact, allows far better-defined centrifugation curves to be obtained, at the same time taking into account the forces used to obtain a given variation of the color index and average absorption.

Of course, the second technique of centrifugation is somewhat laborious and can be used in all those cases where doubts exist on the results obtained with the first, and in all instances where identification of the carbon black is of such importance as to warrant more accurate investigation. The second technique is absolutely indispensable if it is desired to distinguish carbon blacks with almost identical optical behavior, or to identify mixtures of carbon black and white fillers insoluble in nitric acid.

Summary

The determination of the color index of carbon blacks has been the subject of a previous work in which the characteristics of this index, relative methods of examination and its limitations, were outlined.

A description is now given of a method designed to overcome these limitations at least partially, based on the measurement of variations due to the centrifugation of black aqueous dispersions, occurring both in the color index as well as in the concentration of the black in the dispersions. After a description of the methods used for the recovery of the blacks from the compounds, an explanation follows of two different centrifugation techniques, one based on the centrifugation of separate aliquots of the same dispersion, and the other on the centrifugation of the same aliquots.

The results obtained are illustrated by means of graphs in which the color indices are expressed as a function of the variation of the average optical absorption, or as a function of a value which takes into account both the quantity of separated substance and the force used to attain this separation. Some considerations on the optical phenomena involved in spectrophotometric measurements taken on dilute suspensions of carbon blacks, and on the most suitable technique for the preparation of such dispersions follow; finally, there are some comments on the ultraviolet spectra of the dilute suspensions themselves.

ACKNOWLEDGEMENT

The author wishes to thank Mr. Mario Lachin for his notable contribution to the execution of the present work, especially with regard to the second centrifugation technique and comments on optical phenomena.

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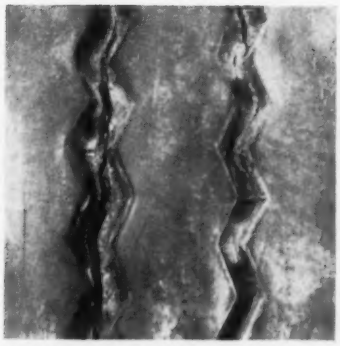
POST-INFLATION: *A new technique for making nylon cord tires helps check common types of damage such as cuts, tread cracking and ply separation*

CUTS



TREAD CRACKING

By C. G. WYMAN

Production Manager, Dayton Rubber Co., Dayton, Ohio

PLY SEPARATION

IN THE rubber industry's continuing quest for methods of building better tires, a significant development has resulted from a cooperative research and testing program involving Dayton Rubber Company and the DuPont Company. Conclusive evidence has been obtained to prove that post-inflation of nylon cord truck tires results in a tire that has low growth and improved resistance to separations and channel cracking.

In addition to effecting these improvements, post-inflation results in another important benefit. Laboratory and road tests have proved that a post-inflated tire built with two less plies still outperforms a non-post-inflated tire with a full ply rating. The post-inflated lower ply tire is cooler running and lighter in weight, and also offers improved treadwear.

Nylon cord truck tires are being widely used for over-the-highway and off-the-road service. Many fleet owners are specifying only nylon cord truck tires because their records have shown that nylon cord tires are less costly in the long run. Pacific Intermountain Express, for example, found nylon cord tires gave an 11.5 per cent lower cost per mile over a period of about three years. In addition, road delays were reduced more than 80 per cent. The more durable nylon cord tires averaged 17 per cent better original tread life than their rayon counterparts, and after 33 months, 56 per cent of the original nylon cord tires

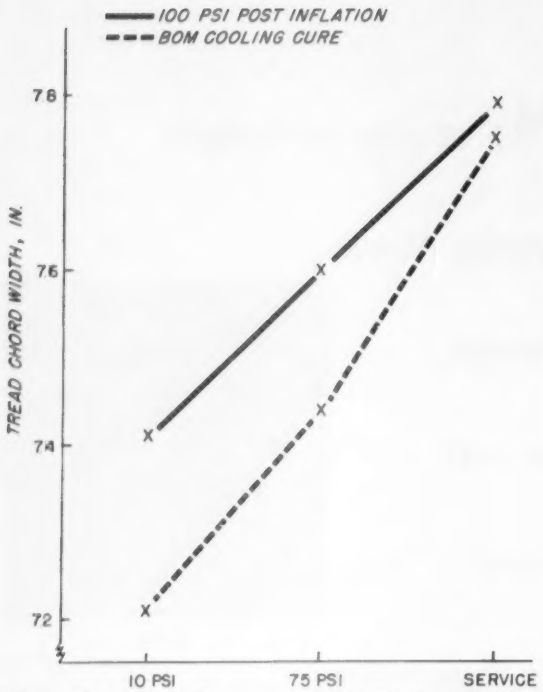


FIG. 1—Effect of post-inflation on tread width (10.00 x 20, 12 ply).

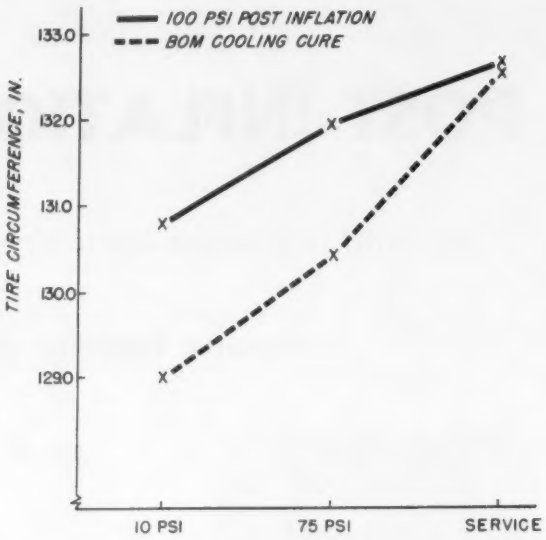


FIG. 2—Effect of post-inflation on tire circumference (10.00 x 20, 12 ply).

were still in service as compared with only 17 per cent of the rayon cord tires. As a result of this experience, Pacific Intermountain Express has specified nylon cord tires exclusively for its fleet.

Even with such proved superiority, nylon cord tires presented some drawbacks to truckers and tire manufacturers. Nylon cord tires cured in present day equipment will contract when removed from the mold, due to shrinkage forces developed in the yarn at curing temperatures. The rubber then takes on its final cure and shape at some point less than mold size. When the tire is put in service, it will grow back to mold size and even larger, depending on the type and amount of nylon reinforcement. This places the cured rubber under tension, making it more susceptible to tread cracking and cuts.

However, these shrinkage forces developed in nylon are also beneficial in the cured tire. At high speeds the shrinkage forces, which oppose the centrifugal forces developed in the crown of a tire, will give wider tread contact and prevent tread chunk-outs. Post-inflated tires have more of this desirable characteristic, since post-inflation prevents loss of the shrinkage force during the cure.

Table I—Post-Inflation Data on 12-Ply Test Tires

Post-Inflation Pressure (psi)	Total Time to Post-Inflate (min.)	Inflated Dimensions Circumference (in.)	Inflated Dimensions Tread Width (in.)	Total Inflation Time	Unmounted Dimensions Circumference (in.)	Unmounted Dimensions Tread Width (in.)
0	0	—	—	0	129.5	7.25
90	12	132.75	7.76	15 hrs.	132.0	7.50
90	13	132.75	7.69	15 hrs.	132.0	7.50
125	13	133.60	7.78	85 min.*	130.9	7.38
135	10	134.00	7.85	85 min.*	130.8	7.40

*Time required for shoulder temperature to reach 150°F. Note: Tires used for post-inflating came out of press at 285°F. shoulder temperature and cooled to 245°F. in 13 minutes.

Post-inflation to Counteract Shrinkage

In any event, the control of tire growth and cracking presented a real challenge, and demanded a solution other than merely using more nylon to reinforce the tire. It was decided to experiment with post-inflation in truck tires to counteract shrinkage during the cure, a method already proven successful in passenger tires. The reasoning here was that inflation of the tire, while hot, to the size of the mold would permit the elastomer to continue curing and cooling at more nearly the dimensions it would achieve in service, thereby reducing the in-service growth.

Engineers from both Dayton and DuPont agreed that reducing the strains in the rubber which resulted from growth would be the solution to channel cracking. This, in turn, might give some additional freedom in compounding for longer tread life. Certainly it would make day-to-day tolerances or differences in tread compounding less critical on this measure of tire performance. The initial investigation of truck tire post-inflation was designed to answer some basic questions concerning the best inflation techniques and to measure the effect of these techniques on the tires.

In September, 1957, a group of 12-ply test tires was constructed under the supervision of Dayton tire engineers and cured in conventional steam dome presses. In approximately 12 minutes after removal from the molds, the tires were debagged, mounted on standard 7½-inch rims, and inflated to various

Table II—Wheel Test Results 10.00 x 20

	Wheel Test Results % Load at Failure	Total Miles
12-ply control	130	2500
12-ply (100 psi Post-Inflation)	160 (No Failure)	9000
10-ply (100 psi Post-Inflation)	160 (No Failure)	9000

pressures ranging from 90 to 135 psi. Measurements of circumference and tread width taken after various periods of inflation proved that the shrinkage could be eliminated in truck tires just as it had been eliminated in passenger tires by post-inflation (Table I).

The dimensional increases which took place during the post-inflation period had the effect, the testers assumed, of extracting part of what heretofore had been considered normal growth in nylon cord tires. Therefore, it could be assumed that in-service growth would be lessened and cracking eliminated.

Results of Wheel Tests

Encouraged by these initial results, Dayton built additional tires, post-inflated them, and conducted a series of wheel tests. These tires were constructed in both 10- and 12-ply designs, post-inflated to 100 psi, and run in comparison with non-post-inflated 12-ply tires. The wheel test results show the superior performance of the post-inflated tires (Table II).

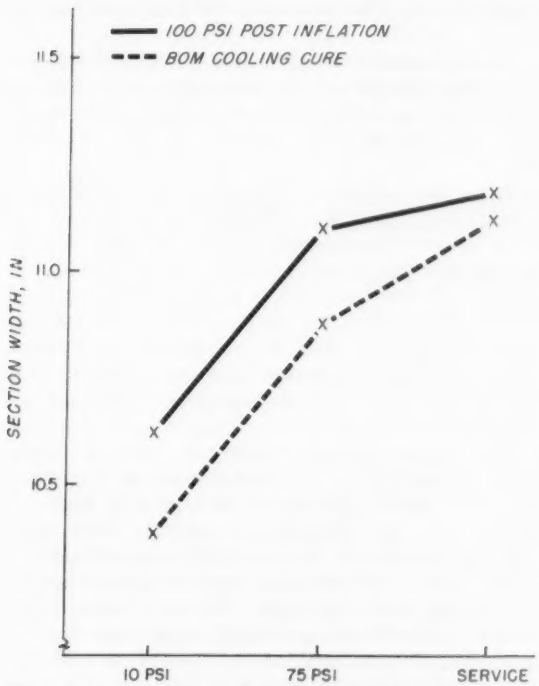


FIG. 3—Effect of post-inflation on section width (10.00 x 20, 12 ply).

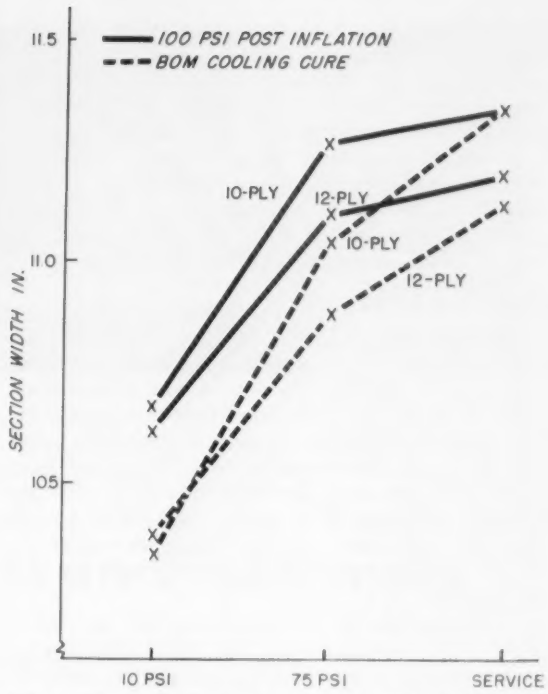


FIG. 4—Effect of post-inflation on section width (10.00 x 20, 10 and 12 ply).

Significantly, the 10-ply post-inflated tire performed better than the 12-ply non-post-inflated tire, carrying a 160 per cent load to the end of the test period without failure, while the 12-ply control failed under a 130 per cent load in less than one-third the running time. While wheel tests were being conducted by both Dayton and DuPont, and achieving similar good results, further comparative studies were also being made of tread width, tire circumference, and section width.

Tread width measurements of tires produced in a conventional Bag-O-Matic cooling cure cycle compared with measurements of tires produced with post-inflation to 100 psi are shown in Figure 1. It is evident that the post-inflated tire had an initially wider tread than the non-post-inflated tire, but that both types achieved virtually identical dimensions after service growth, evidence that post-inflation of nylon cord tires made possible curing of the tires at more nearly the shape and dimensions in which they would be used.

Circumference measurements revealed similar results. The post-inflated tires attained greater circumference initially, and both types were identical after service growth, so that the post-cure contraction which had been typical of nylon cord tires was proved to be eliminated by post-inflation (Figure 2).

Section width measurements further substantiated the assumption that a sizeable reduction in growth could be achieved through post-inflation (Figure 3).

The effects of post-inflation on section width as indicated in Figure 4, which shows cross-section

measurements at various stages of inflation, are such that the manufacturer can exercise closer size control, and eliminate the necessity to overbuild nylon cord tires in order to prevent cracking. By extracting growth through post-inflation, the builder can produce a 10-ply tire that is larger in size than the 12-ply. The economic implications of this achievement are of great importance to tire manufacturers, and the lighter, cooler running tires produced through post-inflation can be equally important to truckers.

Results of In-Service Testing

With the results of these tests and studies in hand, representatives of Dayton and DuPont agreed to cooperate on building a group of post-inflated truck tires for in-service testing, and Dayton's engineering staff instituted a program to develop a means of inflating and cooling that would be more efficient and more economical than doing the job manually. A quick and efficient technique would permit post-inflation when the tires were hotter and more likely to assume the shape in which it is most desirable to have the cure take place.

In December, 1957, Dayton supplied 48 tires—10.00 x 20 12-ply rated, five rib, 840/2 nylon cord—to a Tennessee trucker for road testing and comparison with the results of the laboratory tests. Half of the total number of tires were 10-ply. In both designs there were post-inflated and non-post-inflated tires.

Officials of the truck firm chosen for the road tests had previously reported they were not getting the full service expected of nylon cord tires, because of excessive cracking. Running over routes that included rugged mountain terrain as well as high-speed turnpikes and city streets, the trucks of this company gave tires a real beating. Specially designed high-torque diesels added to tire punishment. If cracking and ply separation could be eliminated by post-inflation, here was the way to find out for sure.

FIG. 5—Tire in the process of being post-inflated. It is locked in place on the rim, inflated, and quenched to reduce the temperature.

Table III—Results of In-Service Fleet Test of Post-Inflated Tires

Grand Average Total Growth	10-Ply P. I.	10-Ply Non-P. I.	12-Ply P. I.	12-Ply Non-P. I.
Inflation	4.20	4.06	3.23	3.60
Service	1.08	2.93	1.03	2.39
Total	5.28	6.99	4.26	5.99
Avg. Tread Wear (Miles/Mil.)	61.3	51.8	58.2	53.9
Tread Cracking	None on 11 tires; slight on one	Medium to bad cracking on all tires	Slight cracking on four tires	Slight to bad on all tires

And the proof was there. In his first report, three months after the trucker began to use the post-inflated tires, the test supervisor submitted evidence of the worth of the system. He reported that all non-post-inflated tires were removed because of tread cracking before the full potential tread mileage was realized. Four of the 24 post-inflated tires had been removed from service for miscellaneous reasons. Tread cracking was prevalent in varying degrees up to very severe in all of the non-post-inflated tires, as compared to only slight traces of cracking in only five of the post-inflated tires.

At the time this report was filed, none of the post-inflated tires had been removed due to cracking. Three had been removed because of baldness, and one had a serious cut. The remaining 20 tires were still in service.

Growth measurements showed that post-inflation had done the job of preventing tire contraction in the period immediately following removal from the mold, and that in-service growth was minimal (Table III).

While these efforts to characterize the post-inflation process were under way, Dayton engineers continued work on an experimental model of post-inflation equipment. The result of their efforts enables the molder to inflate each tire as it comes from the press to 100 psi, using either air or water as the inflating agent. The tire is locked in place on the rim, inflated, then quenched to reduce the temperature from approximately 280° to approximately 120°F. in less than one hour (Figure 5).

The results of the tests leave no room for doubt about the advantages of post-inflation, and Dayton is now post-inflating all nylon cord truck tires from size 10.00 x 20 up. For the tire manufacturer, post-inflation eliminates the necessity to overbuild his product, and cuts down the costs of adjustments due to cracking and separation. For the trucker, post-inflation offers a reduced weight nylon cord tire that is cooler running and more economical. Further refinements in post-inflation may result in even better and more economical nylon cord tires.

Panelists, from left to right: O. Keplinger, H. E. Railsback, E. Tufts, R. M. Savage, G. M. Konkle and A. C. Porter.

New Developments In Elastomers

A Symposium help by the Southern Rubber Group

THE THEME of a symposium held at a meeting of the Southern Rubber Group in Dallas, Texas, on January 30-31 was new developments in elastomers. Five speakers offered a survey of what has been evolved recently in polymer research to meet the ever-increasing demands of service applications. H. E. Railsback, Phillips Petroleum Co., Bartlesville, Okla., delivered an address on polybutadiene polymers, and E. Tufts, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., one on fluoroelastomers.

A paper on polyurethanes by E. E. Gruber and O. Keplinger, General Tire & Rubber Co., Akron, Ohio, was presented by Mr. Keplinger. Two remaining talks on silicone rubbers—one on nitrile silicone rubber, by R. M. Savage, Silicone Products Department, General Electric Co., Waterford, New York, and the other on special purpose silicone polymers, by G. M. Konkle, Dow Corning Corp., Midland, Mich.—completed the program. A. C. Porter, Convair Division, General Dynamics Corp., Fort Worth, Texas, served as moderator. The addresses of the speakers are printed in full herewith.

New Developments in Polyurethanes

By O. KEPLINGER and E. E. GRUBER

The General Tire & Rubber Co., Akron, Ohio

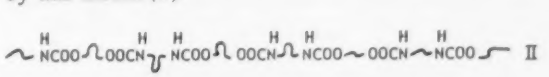
BY NOW almost everyone has encountered the term, polyurethane. Abrasion resistance and durability are probably the primary word associations with polyurethane materials. Other polyurethane characteristics include high tensile; excellent elongation; oil, ozone, and oxidation resistance; and in some cases, reasonably good low temperature properties.

Rubber compounding, of course, is directed toward maximum service for a given expenditure of money. This frequently justifies a high materials cost—another polyurethane characteristic. At any rate, interest in these elastomers has been widespread and reasonably tolerant of the subtle differences in compounding which the urethanes require.

The equation below illustrates the reaction which occurs between an alcohol and an isocyanate to form a urethane (I).

$$RNCO + HOR_2 \longrightarrow RNHCOOR_2 \quad I$$

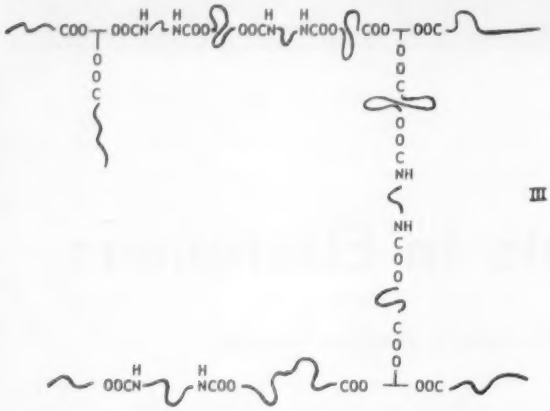
This reaction was first reported by Wurtz in 1848. Despite a considerable use of the reaction during the ensuing years, it was not until 1937 that Otto Bayer of I. G. Farben in Germany prepared a polymer (II) by this means *(1)*.



II

This was a nylon-like material derived from hexamethylenediisocyanate and butanediol. Due to its difunctional components it was linear in structure and thermoplastic in nature.

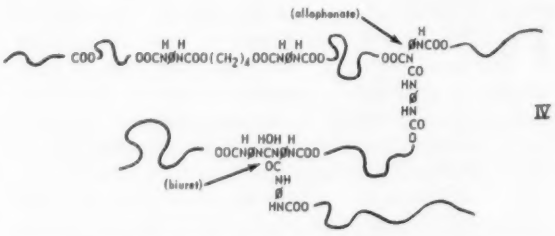
Rubberlike polymers (III) were prepared by Pinten in Germany at about this same time *(2)*.



III

He utilized the reaction between hexamethylenediisocyanate and a low molecular weight polyester which was partially trifunctional in structure, thus permitting the development of cross-links during its reaction with the diisocyanate. The components of the polyester were apportioned so that it was terminated almost entirely by hydroxyl groups. I-gummi was produced by casting the liquid components into a mold and allowing them to cure at elevated temperatures. In spite of large adjustments in the degree of trifunctionality, these products were all reported to have poor tear strength.

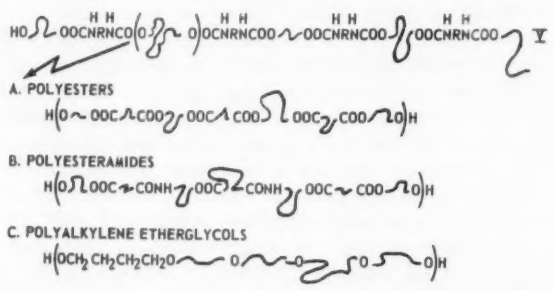
I. G. Farben developed the Vulkollans (IV) by about 1940 *(3)*.



IV

These were cast from linear polyesters and aromatic diisocyanates by a controlled linear extension reaction followed by an attack of the residual isocyanate upon urea and perhaps urethane linkages along the chain to form branches and cross-links. The product of the reaction between naphthalene 1,5 diisocyanate and polyethylene-adipate was found to have outstanding physical properties and excellent resistance to abrasion. Both allophonate and biuret structures are illustrated but the cross-links are predominantly biuret in nature.

Vulcaprene *(4)* was developed in England during the early forties as a millable polyurethane (V).



V

TABLE I—EFFECT OF CARBON BLACK TYPE ON PHYSICAL PROPERTIES OF MILLABLE POLYURETHANE

Formula

	Parts
Genthane-S	100.0
Stearic acid	0.2
Carbon black	25.0
Dicumyl peroxide	
Black compounds	2.0
Gum	1.0

	Carbon Black				
	NONE	FEF	HAF	ISAF	SAF
Tensile, lb./in.²	3650	4480	5450	6130	6240
Elongation, %	900	420	465	575	595
Stress (4L)	150	1720	1850	1760	1590
Notched Crescent Tear	50	210	250	250	275
Shore A	40	71	70	69	69

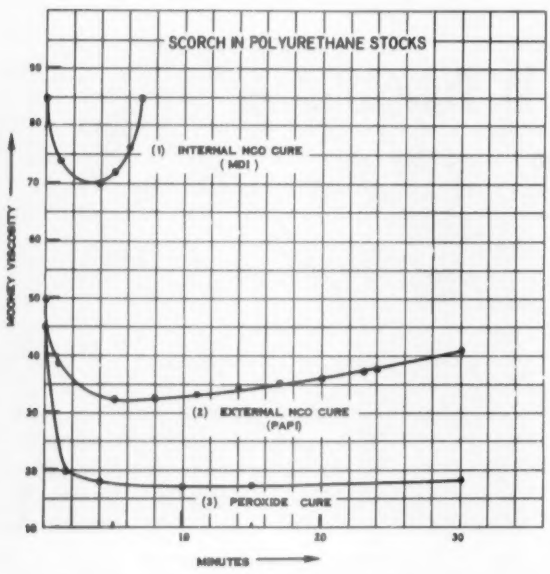


FIG. 1—Scorch in polyurethanes.

TABLE II—HARD GENTHANE-S BLACK COMPOUNDS

Formula	Parts	
Genthane-S	100	
Resin	25	
HAF black	45	
Paraffin	1	
Dicumyl peroxide	As indicated	
Dicumyl peroxide	3	4
300% Modulus, lb./in.²	3450	4175
Tensile, lb./in.²	4755	4760
Elongation, %	440	345
Compression Set B, %	45	38
Notched Crescent Tear, lb./in.	420	360

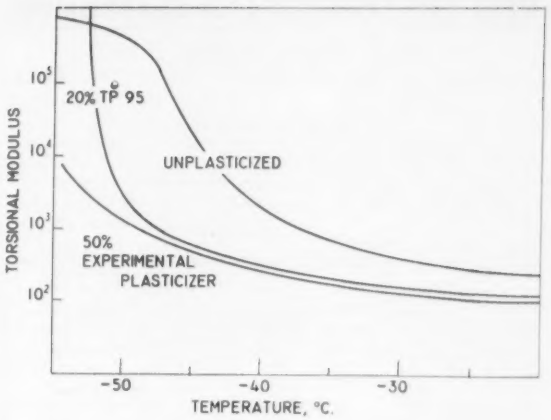


FIG. 2—Stiffening of Genthane-S compositions at low temperatures.

It was compounded with formaldehyde donors and catalysts to effect a cure. In this country Goodyear's Chemigum SL, a polyesterurethane *(5)* and Adiprene-B, DuPont's polyetherurethane *(6)*, were developed as millable gums to be compounded with additional polyisocyanate just prior to molding. Genthane-S is a millable polyesterurethane currently available from the General Tire & Rubber Co. which can be cured by peroxides. Adiprene-C, also from DuPont, is an unsaturated, millable polyetherurethane which cures with sulfur or peroxides. Both Genthane-S and Adiprene-C can be cured by polyisocyanates.

The polyesters, (a), polyesteramides (b), and polyalkylene etherglycols (c), which are useful in this field, are difunctional active hydrogen compounds with a linear chain of from 80 to 300 atoms. In practice, the ends of the chain are terminated by hydroxyl groups so that the primary reaction produces a urethane.

When isocyanates are used for curing in either a cast system or a millable gum, time is of the essence (Figure 1). These stocks scorch easily and cross-link at ordinary temperatures within a few days or even hours. On the other hand, they are but partially cured during the molding operation, difficult to remove from the mold and achieve useful properties only after several days of after-cure in contact with a humid environment.

Polyurethane polymers such as Genthane-S when compounded with dicumyl peroxide have introduced a new order of processability to the industry. Such compounds are quite stable at temperatures below 250° F. This makes it feasible to mill, calender, extrude, or preform the stock by normal factory procedures. When peroxides are used for curing, it also becomes possible to remove a fully cured vulcanizate from the mold. These stocks are quite fluid at molding temperatures and duplicate complex contours with accuracy. Stocks containing dicumyl peroxide may be cured in twenty minutes at 320° F. Compression molds are preferred. Curing in air or oil under pressure might be possible, but open steam cures destroy the rubber.

TABLE III—PROPERTIES OF SILICA REINFORCED GENTHANE-S VULCANIZATES

Formula	Parts
Genthane-S	100.0
Stearic acid	0.2
Hi-Sil 233	55.0
Resin	15.0
Dicumyl peroxide	4.0
300% Modulus, lb./in.²	3480
Tensile, lb/in.²	4975
Elongation, %	385
Notched Crescent Tear, lb./in.	340
Shore A	81

Fillers for Millable Gums

Unlike cast polyurethanes which are degraded by all fillers, millable gums require reinforcing agents. Fine particle blacks are preferred. The best balance of static and dynamic properties is obtained with relatively low loadings of top-grade blacks (Table I).

The properties improve with reduction of black particle size. The increased reinforcement as shown by tensile and tear resistance is noteworthy, and there is a progressive improvement in cut growth resistance.

Hard stocks may be obtained by increased levels of carbon black or alternatively by incorporating 10 to 40 parts of a high styrene resin (Table II). Such stocks are more readily milled and show better mold flow than all-black recipes. Physical properties are maintained and some, such as tear and compression set, are improved. Cure times are reduced by as much as 50 per cent, but the curative requirement is higher.

A full range of colored formulations is possible with Genthane-S using HiSil 233 for reinforcement (Table III). Although such materials do not match the quality of black loaded stocks, color retention and resistance to ultraviolet light are excellent. Poly-

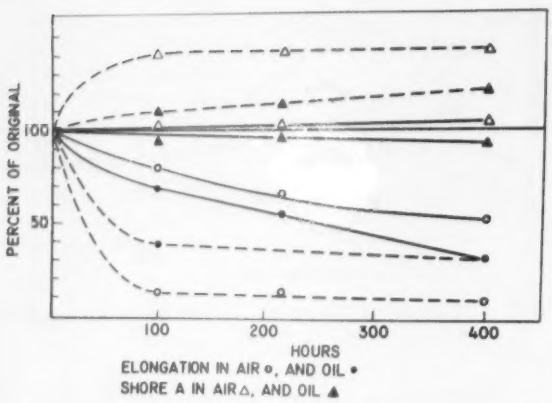


FIG. 3—Aging of experimental polyurethane at 300°F. in air and in ASTM #1 oil.
(Broken line = acrylonitrile rubber; solid line = experimental urethane.)

urethanes are also exceptionally resistant to high energy irradiation. Depending upon the macroglycol used in the polyurethane, some vulcanizates are not brittle even to —70° C. as defined by the Bell Brittle Point Test.

Figure 2 illustrates some typical Clash - Berg measurements of torsional modulus over a range of temperatures. While it may not become brittle, Genthane-S does stiffen in the range of —35° to —40° C. An experimental plasticizer and Thiokol's TP-95 were found to have excellent compatability and to improve low temperature flexibility. All of the known polyurethanes will crystallize under continued stress at about —40° C. and plasticizers merely speed up this process. Further improvements in this direction will probably require a considerable sacrifice in the tensile properties of the successful polymer.

TABLE IV—SWELLING OF GENTHANE S-VULCANIZATES AFTER 120 HOURS AT 300°F.

Formula	Parts
Genthane-S	100.0
Stearic acid	0.2
FEF black	25.0
Dicumyl peroxide	1.7

Fluid	Hardness Change (Points)	Weight Change (%)	Volume Change (%)
Mineral Oil	—50	+0.53	+1.73
ASTM #1	—43	—0.80	—3.46
ASTM 3#	—65		
Dioctyl sebacate	—65		
Air	— 5	—1.17	—1.71
Nitrogen	—21		

TABLE V—AGING OF EXPERIMENTAL URETHANE IN ASTM #1 OIL AT 150°C.

	Original	100 hours	200 hours
Stress at 100% Elongation, psi	425	325	375
Stress at 300% Elongation, psi	1625	1250	
Tensile, psi	3575	1375	1250
Elongation, %	640	320	280
Shore A	73	68	70

Urethanes in general do not swell appreciably in aliphatic or aromatic oils or in ester lubricants at room temperature. However, at temperatures above 150° C., immersed specimens deteriorate rapidly without swelling (Table IV). This has been shown to be accelerated in the absence of oxygen; hence, air aging is much better. At 150° C. in air the useful life of this elastomer is 4 to 6 days; in oil or nitrogen, a matter of 6 to 12 hours.

Improvements in Heat Resistance

Thermal degradation of the polyurethanes has long been considered inevitable. Rather large differences in stability have been found to exist between polyurethanes of various types. Genthane-S, itself, was found to be more than usually stable. A new magnitude of thermal resistance has been demonstrated, however, in recent experimental polyurethanes (Table V and Figure 3.) Instead of degrading completely within a few hours, these vulcanizates retain much of their strength for long periods. Thus, after 200 hours at 150°C. (300°F.) while immersed in ASTM #1 oil, an experimental compound still had a hardness of 70, an elongation of 280 per cent, and 75 per cent of its original modulus. There was no tendency toward brittleness or cracking. In contrast to many acrylonitrile-butadiene stocks, it performed even better in hot air.

These vulcanizates have also been found to resist hydrolytic attack several times as long as earlier polyurethanes. Reasonably good cures have been observed using open steam at high pressures over short cycles instead of compression molding. These experiments suggest that the new elastomer may also prove satisfactory for use in extruded products such as tubing, channel, or wire.

Our own work with this elastomer is very new and further compounding experience must be built up. Nevertheless, we are confident that this work will extend the areas in which polyurethanes perform a useful service.

Conclusion

There are undoubtedly many aspects of the polyurethanes which have been omitted. It should now be possible, however, for those of you who have been interested in the polyurethanes to form a tentative picture.

In our view, the peroxide cured polyesterurethane elastomer seems to have desirable characteristics of high strength; oxygen and ozone resistance; abrasion resistance; resistance to many organic fluids; a high degree of thermal and radiation stability, and unique low temperature properties. Above all is its ease in processing in all phases—from milling to extruding or calendering to its excellent mold duplication, its short curing cycle, and perhaps most important, its freedom from scorch both at reasonable operating temperatures and over prolonged storage after final compounding. In those areas of thermal and hydrolytic stability which have heretofore limited the use of polyurethanes advances are definitely being made.

ACKNOWLEDGEMENT

The authors wish to thank J. H. Brown, who performed much of the compounding described above.

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New Developments in Fluoroelastomers

By E. TUFTS
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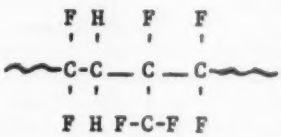
DESIGNERS of aircraft, automotive, and industrial mechanical goods are imposing more and more stringent requirements of heat and fluid resistance on elastomeric parts. They have been limited until recently in their designs by the inability of elastomers to withstand temperatures in excess of 300° F. Further limitations have been imposed by the inability of available elastomeric materials to perform satisfactorily in contact with many fuels, lubricants, and chemicals widely used by industry today.

Over the past decade, specialty elastomers have been developed with much improved heat resistance—or with excellent oil and solvent resistance. Viton synthetic rubber offers a combination of these desirable properties in a single product. It performs satisfactorily in many such applications at temperatures in excess of 400° F. The Viton polymer may be regarded as Teflon tetrofluoroethylene resin which has been modified by introducing a methylene group to give chain mobility and a pendant trifluoromethyl group to give heterogeneity. These two materials are markedly different in physical properties in spite of the similarity in their chemical structure. Teflon is a hard plastic material while Viton is typically elastomeric. The chemical structures of these materials are as follows:

(TEFLON)



(VITON)

TABLE I—VULCANIZATE PROPERTIES OF VITON A AND VITON A-HV

Measured at Room Temperature

	Viton A	Viton A-HV
Modulus at 100%, psi	950	1050
Tensile Strength, psi	2700	3100
Elongation, %	220	230
Hardness, Shore A	71	75
Compression Set, % 70 hr. at 250°F. (Method B) ASTM D-395-55	14	11
Measured at 300°F.		
Tensile Strength, psi	650	850
Elongation, %	80	80

Physical Properties

Viton is made by the copolymerization of vinylidene fluoride and hexafluoropropylene. Typical raw polymer properties are:

Specific Gravity	1.85
Mooney Viscosity	70 to 170
Appearance	White, translucent
Solubility	Soluble in ketones
Storage Stability	Excellent

Viton has a relatively high density and is offered in two viscosity grades—Viton A (70 MS-4 [212° F.], ASTM D 927-53T) and Viton A-HV (170 MS-4 [212° F.], ASTM D 927-53T). It is colorless in the

TABLE II—VULCANIZATE PROPERTIES OF VITON

Low Temperature Properties	
Young's Modulus—10,000 psi (ASTM D-794)	—20°F.
Brittle Point—0.075-inch Test Piece (ASTM D-746)	
0.075-inch Test Piece	—47°F.
0.025-inch Test Piece	—60°F.
0.010-inch Test Piece	—90°F.
Temperature Retractions (ASTM D-1329)	
T_{10}	— 7°F.
Ozone Resistance	
Hours to Cracking	
100 ppm—25% Elongation	>500
Electrical Properties	
Dielectric Strength—(ASTM D-149)	412 Volts/Mil
DC Resistivity—(ASTM D-991)	2.5×10^{12} ohm-cm
Specific Inductive Capacity (ASTM D-150)	16.7
Power Factor (ASTM D-150)	4.5%

raw state, is soluble in ketones and has excellent storage stability.

Viton was introduced experimentally a little more than two years ago and has been so well received that it has been necessary to expand manufacturing facilities to a commercial scale, which was done in the spring of 1958. Its excellent balance of properties and its ability to be processed on conventional rubber equipment make it a unique material.

Physical Properties of Vulcanizates

Typical vulcanizate properties for Viton A and Viton A-HV are shown in Table I. Through variations in the formulation, tensile strengths from 2000 to 3000 psi, elongations from 100% to 400% and hardness from 60 to 95 (Shore A) may be obtained. These room temperature properties are acceptable for most elastomers and are particularly good for one with exceptional resistance to heat and fluids. At 300° F. tensile strengths as high as 1100 psi and elongations greater than 100% can be obtained, indicative of Viton's good high temperature strength compared to most conventional materials.

Viton has excellent resistance to compression set at elevated temperatures. With most conventional rubbers this property is determined at 158°F. or 212° F. where values of 25% would be considered good. Compression set of Viton is usually measured at 250° F. with values of 10 to 15% being common.

Other typical properties of Viton vulcanizates are shown in Table II. The low temperature properties of Viton are not outstanding, but are adequate for most applications. As shown, brittle point will depend on the thickness of the vulcanizate. For example, thin wire coatings will not crack at —90° F. when bent around a mandrel ten times the wire diameter.

Viton has excellent resistance to ozone and to oxidation and weathering. After 12 months exposure to direct sunlight, no cracking has occurred on test samples. Viton's electrical properties restrict it to low voltage, low frequency applications where insulation from dry heat or hot oil would be required.

Resilience is reasonably good at room temperature and increases markedly with increasing temperature. Dynamic modulus decreases as temperature increases, but unlike other rubbery materials, Viton will maintain its dynamic modulus after long exposures at 300° F.

Heat Resistance

The high quality physical characteristics discussed thus far are in a sense bonus properties over outstanding heat and chemical resistance of Viton which has aroused the principal interest among users of rubber products. The various temperatures and lengths of exposures for which Viton vulcanizates remain usefully elastic—elongation is 100% or more—are:

400°F.	>2400 hours
450°F.	1000 hours
500°F.	250 hours
550°F.	72 hours
600°F.	24 hours

Exposures were made in a circulating air oven.

Most conventional rubbers embrittle or revert to a plastic state on continuous exposure at 250° F. to 300° F. At these temperatures, Viton remains unaffected for extended periods of exposure. The retention of properties of its vulcanizates after 14 and 28 days exposure at 450° F. are:

	After 14 Days	After 28 Days
Tensile Strength	90%	90%
Elongation	60%	50%
Hardness	+4 points	+9 points

TABLE III—VITON FLUID RESISTANCE VERSUS CURE

% Volume Swell—7 Days

Exposure Conditions	No Cure	24 hr. in Boiling Water	30 min. at 300°F. Press	30 min. at 300°F.—Press 24 hr. at 400°F.—Oven
Reference Fuel B @ 75°F.	1	1	2	1.0
Benzene @ 75°F.	13	12	19	19.0
Carbon Tetrachloride @ 75°F.	1	1	1	1.0
Water @ 212°F.	11	6	11	5.0
Oronite 8200 @ 400°F.	80	2	2	1.5
DOS @ 400°F.	80	8	9	11.0
36% HCl @ 160°F.	8	..	..	1.5

TABLE IV—FLUID RESISTANCE OF VITON

7 Day Exposure

Media	% Volume Swell	Tensile Retained, %	Points Hardness Change
Carbon Disulfide @ 75°F.	1.2	98	—11
JP-5 @ 75°F.	0.4	100	+ 1
Sulfuric Acid, Fuming @ 75°F.	4.8	58	— 4
Carbolic Acid @ 300°F.	18.4	71	—17
Sulfuric Acid, 60% @ 250°F.	5.2	102	— 3
Petroleum Oil, Crude @ 300°F.	1.4	91	— 9
Turbo Oil #15 @ 400°F.	16.3	64	—13
Cotton Seed Oil @ 300°F.	1.0	93	— 5
Perchloroethylene @ 158°F.	7.5	89	— 7
NaOH (50%) @ 158°F.	5.1	89	— 8
Xylene @ 158°F.	18.2	72	—12

TABLE V—COMPOUNDING FOR MAXIMUM HEAT RESISTANCE

	Parts	
Viton A	100.0	100.0
Zinc Oxide/Dyphos	20.0	
Magnesium Oxide		20.0
MT Carbon Black	25.0	25.0
Diak No. 1	1.3	1.3
Cure: Press 30 min. @ 300°F.; Oven 24 hr. @ 400°F.		
Original Properties		
Tensile Strength, psi	2500	2700
Elongation, %	270	265
Hardness, Shore A	70	72
Compression Set, %—ASTM D-395-55: 70 hours, at 250°F. (Method B)	19	19
After 16 Hours at 600°F.		
Tensile Streangth, % Retained	40	63
Elongation, % Retained	15	43
Hardness, Points Changed	+23	+10

After 28 days exposure at 450° F., Viton loses only 10% of its strength, shows slight hardening and retains 50% of its original elongation.

Fluid Resistance

Another outstanding characteristic of Viton is its resistance to many fluids—oils, lubricants and chemicals—both at room temperature and at elevated temperatures. In general, it is more resistant to more fluids than any other commercial elastomer. About the only materials that swell Viton severely are highly polar materials such as low molecular weight esters and ketones. Its inertness to most materials makes state of cure relatively unimportant, as is illustrated in Table III.

The normally recommended cure is 30 minutes at 300° F. in a press followed by an oven cure of 24 hours at 400° F. With the exception of the two fluids tested at 400° F., the degree of cure shows little effect on chemical resistance. With Oronite 8200 (silicate ester hydraulic fluid) and dioctyl sebacate the increase in volume results from sponging, which occurs normally with Viton if the 400° F. post cure is not preceded by a lower temperature precure. As little as 30 minutes at 300° F. gives sufficient cure to produce resistance to sponging on fluid exposure at 400° F. These results point the way to less rigorous cures where solvent resistance is the major factor requiring the use of Viton, such as tank linings or fuel handling equipment. Further data are shown in Table IV to illustrate this polymer's excellent chemical resistance.

Uses

The major uses for Viton so far have been in missiles, aircraft and automotive fields where its combination of heat and fluid resistance is required for O-rings, shaft seals, packings and gaskets. It is also finding applications in pump and valve parts because of its chemical and solvent resistance. Other applications which have and are attracting interest include: coated fabric (on Teflon or glass fabric), for protective clothing and fuel cells, wire insulation, caulks, paints, hydraulic hose for high temperature and pressure service, chemical hose, rolls and tank linings.

Compounding

Viton compounds contain three basic elements besides the polymer: a stabilizer, a filler, and a curing agent.

Stabilizer. A stabilizer is needed to produce a high state of cure and maximum heat resistance. The stabilizer generally used is either magnesium oxide at the 15 to 20 part level or a combination of ten parts each of zinc oxide and dibasic lead phosphite (Dyphos). The latter system produces less scorchy stocks, but vulcanizates containing magnesium oxide are more heat resistant. A comparison of these two systems is shown in Table V, which illustrates the better retention of elastomeric character of the vulcanizate containing magnesium oxide after 16 hours aging at 600°F.

The grade of magnesium oxide used influences the final properties to a considerable extent as is shown in Table VI. Just what characteristics of magnesium oxide make one grade perform differently from another is difficult to say at this time. However, these data emphasize the necessity for careful selection of magnesium oxide in compounding.

TABLE VI—COMPARISON OF MAGNESIUM OXIDES IN VITON STOCKS

	Type A	Type B
Original Properties		
Tensile Strength, psi	1650	2700
Elongation, %	300	265
Hardness, Shore A	72	72
Compression Set, %—ASTM D-395-55: 70 hours at 250°F. (Method B)	67	19
After 16 Hours at 600°F.		
Tensile Strength, psi	570	1700
Elongation, %	300	115
Hardness, Shore A	74	82

A third stabilizer, litharge, is currently under evaluation. Litharge markedly improves the chemical resistance of Viton vulcanizates to highly corrosive and oxidizing chemicals. The improvements in chemical resistance obtained by the substitution of litharge for magnesium oxide are shown in Table VII. Stocks containing litharge characteristically are not as safe processing as those containing magnesium oxide.

Fillers. A wide variety of fillers including carbon blacks, clays and silica compounds can be used in Viton. Fillers improve processing, increase modulus and hardness and reduce elongation. Smaller amounts of filler are used than in conventional elastomers to avoid excessive stiffness since plasticizers are not generally used with Viton. The choice of filler has little effect on the heat resistance of vulcanizates and only a slight effect on the fluid resistance. As a general rule, a 20 volume loading of MT carbon black produces maximum tensile strength and good all-around fluid resistance.

Curing Agent. Viton compounds can be cured with peroxides, high energy radiation or some polyfunctional amines. (In connection with any use of the peroxide curing process, attention is directed to U. S. Patent No. 2833752, assigned to Minnesota Mining and Manufacturing Co.) Preferred formulations employ polyamines. Since unmodified aliphatic polyamines such as hexamethylene diamine or triethylene tetramine prove too scorchy, a blocked diamine such as hexamethylene diamine carbamate (Diak No. 1) is used to provide improved processing safety and good vulcanizate properties. Diak No. 1 is used in nearly all Viton compounds today.

Processing safety of stocks accelerated with Diak No. 1 may be improved by using Copper Inhibitor 65 in combination with Diak No. 1. Copper Inhibitor 65 acts as a retarder at processing temperatures and during the 400° F. post cure it acts as an accelerator. Thus, when Copper Inhibitor 65 is used, the amount of Diak No. 1 should be reduced. Copper Inhibitor 65 reduces the adhesion of Viton to most substrates and should not be used when maximum adhesion is required.

Another good blocked diamine is Diak No. 2, which is ethylene diamine carbamate. Stocks containing Diak No. 2 are three to four times safer than those with Diak No. 1, used without Copper Inhibitor 65, yet 0.85 parts of the former produces states of cure equivalent to those with one part of Diak No. 1. Diak No. 2 is more easily dispersed than Diak No. 1, and therefore does not require remilling. A comparison of the processing safety of these three curing systems is shown below:

Mooney Scorch Measured at 250°F. (ASTM D 927-55T)

	Minutes to 10 Point Rise	
	Viton A	Viton A-HV
Diak No. 1	12	6
Diak No. 1/Copper Inhibitor 65	25	15
Diak No. 2	45	25

Table VIII shows all the principal curing systems for Viton compounds. Compounds A and B have already been discussed in reference to the fact that vulcanizates containing magnesium oxide exhibit better heat resistance but poorer scorch resistance than those containing zinc oxide/Dyphos. Compound C has been developed for hydraulic aircraft hose. Viton A-HV, with relatively high loading and a high level of acceleration, produces a high modulus vulcanizate. Such characteristics are necessary to prevent fissuring under fluid exposure at high temperatures and pressures. Copper Inhibitor 65 is necessary to reduce the scorch to an acceptable processing level. Compound D is typical for a Diak No. 2 acceleration in which 1.3 parts is equivalent to 1.5 parts Diak No. 1 as shown in Compound A.

The last compound, Compound E, incorporates benzoyl peroxide as the curing agent. Stocks containing peroxide are difficult to process. They are improved by using Copper Inhibitor 65, but develop a low state of cure.

Processing Principles

Mixing. Viton stocks should be mixed on a cold mill to minimize heat build-up and to avoid sticking. The polymer bands readily and does not breakdown appreciably with prolonged milling, so ingredients may be added as soon as the band is formed.

Usually the stabilizer is added first, then the filler followed by blending. It is sometimes helpful to add the stabilizer and filler simultaneously. Lastly, the curing agent is added followed by blending and refining. For maximum tensile strengths and uniform vulcanizate properties it is quite important to insure thorough dispersion of the curing agent. As was pointed out previously, Diak No. 2 is more easily dispersed than Diak No. 1 and normally does not require a remilling. Diak No. 1 stocks should be remilled after the stock has cooled for several hours, in order to obtain an acceptable dispersion.

Air is very soluble in Viton. Air entrapment in the stock can be minimized by allowing the stock to roll undisturbed for one minute and then stopping the mill to permit the stock to cool. The mill is then opened, turned one-half revolution to bring the bank to the cutting area and the stock cut at the bank and removed from the mill. Preforms or slabs are then taken from the stock which was next to the roll.

Extruding and Calendering. Viton stocks will ex-

TABLE VII—LITHARGE VERSUS MAGNESIUM OXIDE IN VITON STOCKS

Chemical	% Volume Swell After 7 Days	
	Magnesium Oxide	Litharge
36% HCl @ 158°F.	180.0	1.5
70% HNO_3 @ 75°F.	27.1	2.7
Fuming Sulfuric Acid @ 75°F.	7.0	2.0
Red Fuming Nitric Acid @ 75°F.	122.0	22.9

trude very well in conventional extruders. A barrel temperature of 150° F. and a head temperature of 200° F. are suggested. It is sometimes helpful to heat the die to 250° F. Viton A-HV stocks require extrusion aids to provide smooth extrudates (for example, 5 to 7 parts of dioctyl sebacate or tricresyl phosphate).

In calendering it has been found that Viton stocks release satisfactorily from rolls at 125° F. Where fabric is to be coated with Viton, a solution of the stock in MEK should be applied to the fabric and dried before calendering.

Molding and Curing

Viton is cured in two phases. The first is a press cure, normally 30 minutes at 300 to 325° F., which is used to form the article and develop sufficient strength or modulus so that it will have dimensional stability during the higher temperature oven cure. This also permits trapped air to diffuse out without rupturing the stock during oven cure. The second phase of vulcanization is usually carried out in a circulating air oven. Normally 24 hours at 400° F. is used to ensure development of maximum physical properties. It is sometimes advisable to include a step cure in the oven to permit gradual warm-up and complete diffusion of trapped air. This is particularly true for thick pieces.

The linear shrinkage of vulcanizates which have been fully cured is about 3.1% for Viton A and about 2.7% for Viton A-HV. A very effective mold release for Viton is either Aquarex L or a mixture of Aquarex L and DC-35 silicone lubricant, used as a 1% solution in water.

Other Considerations

Since Viton is an expensive product, it is economical to recover any material which can be reprocessed. Scrap which has not undergone the final oven cure at 400° F. (which may result from poor moldings, mold flash, and excess stock) can be remilled and as much as 20 per cent may be added to fresh compound without affecting physical properties significantly.

TABLE VIII—VITON CURING SYSTEMS

	A	B	C	D	E
Viton A	100	100	..	100	100
Viton A-HV	..	..	100	..	..
Magnesium Oxide	15	..	15	15	15
Zinc Oxide/Dyphos	..	20	..	..	..
MT Carbon Black	25	25	60	25	..
Fine Silica/Silicone Oil	..	..	..	..	20
Copper Inhibitor No. 65	..	..	1.5	..	0.5
Diak No. 1	1.5	1.3	1.0	..	..
Diak No. 2	..	..	..	1.3	..
Benzoyl Peroxide	..	..	..	..	2

Applications such as tank linings, rolls and some gaskets require that the elastomer be bonded to a substratum. Viton stocks can be tightly bonded to a variety of metals by using a primer or adhesive such as Chemlok 607 or Thixon UM-1. These bonds will withstand temperatures up to 500° F. For adhesion where service temperatures will be 500° F. or more, a Viton cement, used as both the primer and the adhesive, is recommended. As previously mentioned, Copper Inhibitor 65 reduces the adhesion of this elastomer to substrates.

There are many applications which utilize solutions of elastomer compounds. For example, fabrics which are coated with Viton solutions will find wide usage for protective clothing, fuel cells and pump diaphragms. Solutions may also be used as protective coatings and may be applied by brushing or dipping. Smooth stable solutions of Viton compounds can be prepared by dissolving the stock in MEK, acetone, isobutyl acetate or methyl isobutyl ketone. The relative stability of the solution is dependent upon the activity of the curing agent. Diak No. 1 accelerated solutions are stable for 1 to 2 weeks while those containing triethylene tetramine have a pot life of 8 to 16 hours. Both accelerator systems will develop a fair state of cure at room temperature but some heat is necessary to obtain maximum properties.

New Developments in cis-Polybutadiene Elastomers

By H. E. RAILSBACK
Phillips Petroleum Co., Bartlesville, Oklahoma

NO EVENT in recent years in the high polymer field has created more stir or attracted more interest than has the development of catalysts and polymerization systems to make polymers of controlled structure. Such polymerization systems can be used to make *cis* or *trans* linear polydienes, polymers by 1,2-reaction containing vinyl side chains, or high-melting, crystalline "isotactic" or "syndiotactic" polyolefins of controlled optical configuration.

Of the products made to date by these methods, the one that has received the most attention has been *cis*-polyisoprene, the so-called synthetic natural rubber. This is understandable in view of the fact that the goal of high polymer chemists for many years was to make a product identical with Hevea. Furthermore, with constantly increasing demands for rubber products, and a relatively constant supply of natural rubber, it is expected that an increasing shortage of natural rubber will develop in the future.

In April, 1956, Phillips Petroleum Co. announced

TABLE I—BASIC TREAD RECIPES

Cure: 30 minutes @ 307°F.

	cis-Polybutadiene	Type 1500 Styrene Rubber	No. 1 Smoked Sheets
Rubber	100	100.00	100.0
Philblack O	50	50.00	50.0
Zinc Oxide	3	3.00	4.0
Stearic Acid	2	2.00	3.0
Flexamine	1	1.00	1.0
Resin 731D	3	...	...
Philrich 5	10	10.00	5.0
Sulfur	Variable	1.75	2.0
Accelerator	Variable	1.20	0.5

the preparation of several elastomers of controlled structure, including *cis-* and *trans*-polybutadienes. Subsequently, procedures have been developed for making a whole series of linear polybutadienes by 1,4-reaction of butadiene, varying in *cis-trans* ratio from above 95 per cent *cis* to 93 per cent *trans*.

Since it is not made up of isoprene units, *cis*-polybutadiene is not "synthetic natural rubber;" however, it has some of the characteristics of Hevea, and for economic reasons *cis*-polybutadiene may prove to be of more interest than *cis*-polyisoprene in extending the supply of natural rubber. According to an article in the January 11, 1958, *Wall Street Journal*, the major stumbling block to the early commercial development of *cis*-polyisoprene is the unavailability of commercial supplies of isoprene of the required high purity. A costly isoprene plant as well as the polymerization facilities will have to be provided before commercial quantities of *cis*-polyisoprene can become a reality.

This is not the case with *cis*-polybutadiene; adequate facilities are now available to manufacture all foreseeable requirements of butadiene, and the present commercial grade of material requires no further purification (except drying) for use in the *cis*-polybutadiene process. This, plus the fact that butadiene seems to be inherently a lower cost material than polymerization grade isoprene and the fact that certain properties

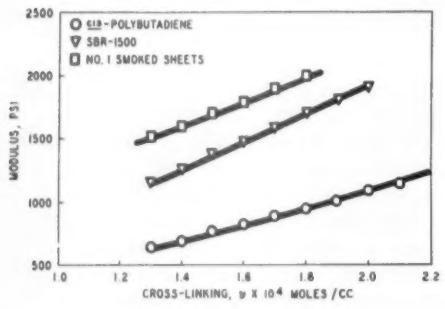


FIG. 1—Effect of cure on modulus.

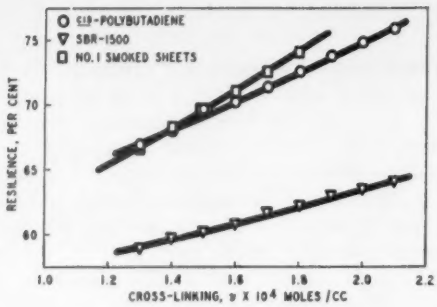


FIG. 2—Effect of cure on resilience.

of *cis*-polybutadiene are equivalent to natural rubber, indicates that *cis*-polybutadiene should not be overlooked as a potential commercial polymer to extend the supply of natural rubber.

The product I want to talk about is one of 95 per cent *cis* content. Polymers of this type have been designated "Cis-4" polybutadiene.

Physical Properties

Interest has been stimulated in polybutadiene rubbers of high (95 per cent) *cis*-configuration because of the unusually low heat generation and high resilience observed in the vulcanizates. These polymers have also exhibited outstanding laboratory abrasion resistance.

Typical tread recipes for high *cis*-polybutadiene, type 1500 styrene rubber and No. 1 smoked sheets are shown in Table I.

Processing. High *cis*-polybutadiene rubbers are smooth and glossy and mill extremely well if kept cool; however, high Mooney rubbers do not mill easily at elevated temperatures without special compounding. The processing data in Table II show the effect of the Mooney viscosity on the extrusion characteristics of rubbers of this type. All of the stocks were compounded by the recipes shown in Table I.

TABLE II—EFFECT OF MOONEY VISCOSITY ON EXTRUSION PROPERTIES

Polymer	Raw ML-4 at 212°F.	Compounded MS-1½ at 212°F.	Garvey Die Extrusion at 250°F. Inch Minute	Gram Minute	Rating*
cis-Polybutadiene	26	23.5	40	88	10
	33	32.5	28	62	8
	43	34.5	27	67	7
	56	41.5	24	57	6
	73	48.0	24	53	6
Type 1500 Styrene Rubber	52	25.5	56	109	12—
No. 1 Smoked Sheets	88	37.5	44	92	11+

*Rated on surface, edge and corner; 12 is perfect.

TABLE III—PROPERTIES OF *cis*-POLYBUTADIENE AT EQUAL CROSS-LINKING

Polymer	Sulfur (phr)	Santocure, (phr)	Cross-linking, $\nu \times 10^4$ (Moles/cc)	300% Modulus, (psi)	Tensile, (psi)	Elongation, (%)	Resilience, (%)	Shore A Hardness
cis-Polybutadiene	1.25	1.0	1.59	830	2420	585	71	56.0
	1.50	0.8	1.58	800	2475	620	71	55.5
	1.75	0.6	1.46	720	2510	645	69	55.0
Type 1500 Styrene Rubber	1.75	1.2	1.37	1260	3315	680	59	58.0
No. 1 Smoked Sheets	2.00	0.5	1.46	1720	3775	550	70	60.0

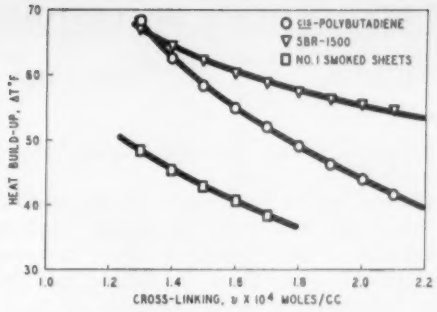


FIG. 3—Effect of cure on heat build-up.

These *cis*-polybutadiene rubbers extrude fairly rapidly as long as raw Mooney is low. Extrusion rating, as expected, becomes poorer as the raw Mooney of the polymer is increased.

Physical Properties of the Vulcanizates. The physical properties of a 40-Mooney, 94.5 per cent *cis*, 1.8 per cent *trans* and 3.7 per cent vinyl rubber are shown in Table III. In these black reinforced vulcanizates sulfur and accelerator have been adjusted to obtain essentially equal cross-linking.

A very significant trend in physical properties is apparent from these data; i.e., high *cis*-polybutadiene gives very low modulus and Shore hardness and high resilience at this cross-linking level. Styrene and natural rubber tread stocks are normally compounded to obtain cross-linking values in the range of 1.4 to 1.6 x 10^{-4} moles per cc. Although it is possible that the parameters used to calculate the cross-linking of *cis*-polybutadiene could be too high, this seems doubtful. It appears more likely that the 95 per cent *cis*-polybutadiene stocks are actually below optimum cure at this cross-linking level.

Since modulus and hardness properties indicated Cis-4 polybutadiene stocks were undercured at cross-linking levels of 1.4 to 1.6 x 10^{-4} moles per cc, studies of the effect of tighter cures (increased cross-linking) on the modulus and hysteresis properties were undertaken. The results in Figure 1 show that when cross-linking is increased to 1.9 to 2.0 x 10^{-4} moles per cc, the modulus displayed by Cis-4 polybutadiene rubber vulcanizates approaches that given by normal type 1500 styrene rubber tread stocks.

The plot of the resilience data in Figure 2 shows that a substantial increase in the resilience occurs as cross-linking is increased and that the high *cis*-rubber is equivalent to natural rubber in this property in the recipe used. However, the most important trend appears in Figure 3. At low cross-linking (1.3 x 10^{-4} moles per cc) this 95 per cent *cis*-polybutadiene is essentially equal to styrene rubber in heat build-up and significantly poorer than the No. 1 smoked sheet control. As the level of cure (cross-linking) is increased, the heat build-up displayed by the high *cis*-rubber decreased much more rapidly than for either of the controls.

It is fortuitous that the inherently low modulus and Shore hardness given by carbon black reinforced Cis-4 polybutadiene rubbers permit higher cross-linking or tighter cures than are normally considered optimum for styrene and natural rubber. In Table IV selected physical properties of a 40-Mooney high *cis*-polybutadiene tread stock have been summarized and compared to type 1500 styrene rubber and natural rubber at cross-linking levels that appear optimum for each type of rubber.

These data show slightly lower modulus and the characteristically low tensile strength for the Cis-4 polybutadiene tread-stock compared to the styrene and natural rubber. However, excellent hysteresis properties, fully equivalent to the natural rubber control, are obtained and blowout resistance is superior to that of either control stock.

TABLE IV—TYPICAL PROPERTIES OF HIGH *cis*-POLYBUTADIENE TREAD STOCK

Cross-linking, $\nu \times 10^4$ (Moles/cc)	300% Modulus, (psi)	Tensile, (psi)	Elongation, (%)	Tensile at 200°F., (psi)	Heat Build-up (°F.)	Resilience, (%)	Blowout at 200°F. (Min.)	Shore A Hardness
			95% cis-Polybutadiene					
2.0	1260	2500	500	1380	39	76	>120	62.5
			Type 1500 Styrene Rubber					
1.5	1450	3400	580	1520	67	62	9	60
			No. 1 Smoked Sheets					
1.4	1500	3800	520	2680	46	70	9	61

Blends with Natural Rubber

If an experimental polymer is to be readily accepted by the consumer it should have good processing characteristics. In general, to be acceptable in this respect, a polymer should be easy to compound on commercial equipment, it should have enough green tensile and tack to handle satisfactorily in the factory and must extrude smoothly and at a high rate.

Cis-4 polybutadiene mills like styrene rubber at temperatures below 110°F. when compounded in conventional tread type recipes. At a temperature of approximately 110°F., however, rubbers in the 30- to 40-Mooney range and higher display an obvious transition, and at higher temperatures the compounded stocks are too short and weak to band on the roll mill.

Although 20-Mooney *cis*-polybutadiene can be processed alone it imparts slightly higher heat build-up than desired. In limited tests it was discovered that blends of *cis*-polybutadiene and natural rubber could

be processed easily and a complete evaluation program was initiated.

Processing. A 1:1 blend ratio was chosen to study the effect of the Mooney of the *cis*-polybutadiene on the properties of such blends. A rubber compounder would normally use more plasticizer with higher Mooney polymers; however, in order to limit the variables, a common level of plasticizer and accelerator was employed in this investigation. The recipe is shown in Table V.

On a 6 x 12 roll mill at 158°F. the time required to blend the two polymers increased from 2.75 to 5 minutes as the Mooney of the *cis*-polybutadiene varied from 14 to 81 ML-4. The polymers will not band smoothly until completely blended and experience has shown that addition of the compounding ingredients before homogeneity is attained will result in poor dispersion and low tensile strength.

Increasing the Mooney of the *cis*-polybutadiene increased the compounded Mooney of the blend stocks and gave poorer processability at the plasticizer level employed (Figure 4). When the raw Mooney of the *cis*-polybutadiene exceeded the 40-Mooney range, the blends became harder to keep banded tightly after compounding. The extrusions also became rougher in appearance. The modulus and resilience increased and the heat build-up decreased; ultimate tensile (Figure 5) and elongation (not shown) remained fairly constant. With higher levels of plasticizer the blend with even 81-Mooney *cis*-polybutadiene should process as easily as the other blends; however, from the standpoint of keeping the plasticizer as low as possible and blend time short, *cis*-polybutadiene polymers in the 35- to 45-Mooney range were selected for further study.

TABLE V—COMPOUNDING RECIPE OF *cis*-POLYBUTADIENE-NATURAL RUBBER BLEND

cis-Polybutadiene	50.0
No. 1 Smoked Sheets	50.0
Philblack O	50.0
Zinc Oxide	3.0
Stearic Acid	3.0
Antioxidant	1.0
Philrich 5	5.0
Sulfur	2.0
Santocure	0.6

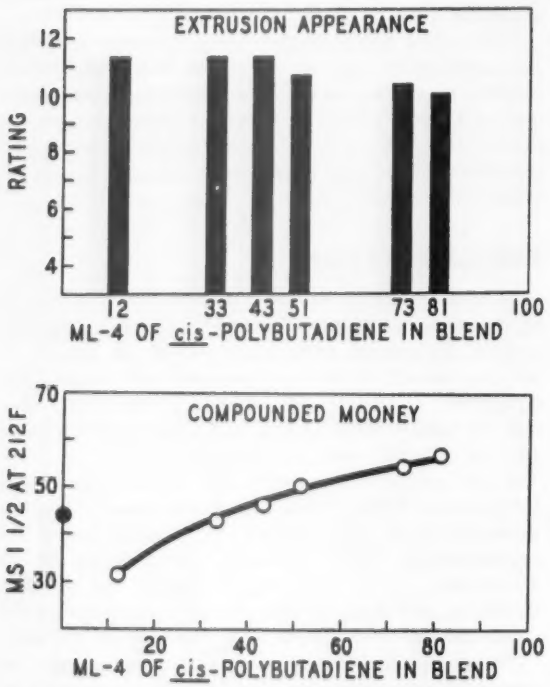


FIG. 4—Effect of Mooney viscosity of *cis*-polybutadiene on processing properties of blends.
(Circle = 1:1 blend stocks; dot = No. 1 smoked sheets.)

It was known (from limited screening studies) that low tensile strength would be obtained with mill mixed blends if these were compounded before complete homogeneity was attained. Since the Banbury is a more efficient mixer it was considered that, when using this machine, a homogeneous blend of the rubbers might not be necessary before black addition in order to obtain satisfactory properties. The time required to blend 40-Mooney *cis*-polybutadiene with natural rubber in a "B" Banbury (158°F., 87 rpm) was found to be 2.5 minutes. This was determined by the appearance of the raw rubber, power requirements and temperature build-up. Therefore, the two polymers were blended 0.5, 1.0, 2.0 and 2.5 minutes prior to the addition of the black and chemicals. The mixing time was kept constant at four minutes.

All of the Banbury mixed stocks had good pigment dispersion and banded readily on a 158°F. roll mill. The physical properties of the vulcanizates were simi-

TABLE VI—EFFECT OF ACCELERATOR AND SULFUR LEVEL ON PROPERTIES OF 1:1 *cis*-POLYBUTADIENE-NO. 1 SMOKED SHEET BLENDS

Sulfur, (phr)	NOBS Special, (phr)	Cross-linking $\nu \times 10^4$ (Moles/cc)	Compression Set, (%)	300% Modulus, (psi)	Tensile, (psi)	Elongation, (%)	Heat Build-up, (°F.)	Resilience, (%)	Shore A Hardness
ORIGINAL									
1.25	1.2	1.64	12.3	1520	3360	540	41.2	73.0	59.0
1.75	0.8	1.67	15.1	1425	3300	545	41.5	73.0	59.0
2.00	0.6	1.53	18.5	1370	3210	570	42.2	71.7	58.5
2.00	0.8	1.77	14.1	1700	3350	520	37.5	75.0	60.5
2.50	0.4	1.42	24.0	1160	3150	610	50.0	70.9	56.0
2.50	0.6	1.76	18.7	1500	3000	500	39.5	75.0	60.0
Natural Rubber Control									
2.00	*	1.31	14.1	1930	3840	520	40.5	70.3	62.0
CIRCULATING AIR OVEN AGED 24 HOURS AT 212°F.									
1.25	1.2	—	—	1950	2700	390	38.8	75.4	63.5
1.75	0.8	—	—	2020	2425	360	37.1	75.7	64.5
2.00	0.6	—	—	1940	2690	400	36.8	76.5	65.0
2.00	0.8	—	—	2210	2600	350	37.1	76.8	66.5
2.50	0.4	—	—	1840	2280	370	40.2	74.8	63.5
2.50	0.6	—	—	2250	2450	330	35.8	77.5	66.0
Natural Rubber Control									
2.00	*	—	—	2340	2900	390	39.9	73.3	66.0

* Recipe identical to control stock shown in Table I.

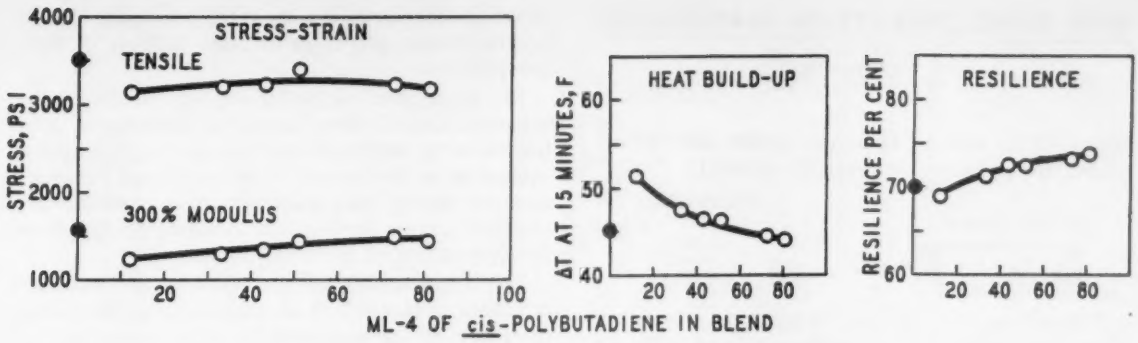


FIG. 5—Effect of Mooney viscosity of *cis*-polybutadiene on physical properties of blends.
(Circle = 1:1 blend stocks; dot = No. 1 smoked sheets.)

lar for stocks mixed at all the blend times and were equivalent to those of the mill mixed control. Apparently, with the more efficient Banbury mixer a lengthy premix time is not necessary; however, premasticated natural rubber would probably be desirable for obtaining uniform blends most quickly.

Physical Properties of Blends. To characterize the physical properties of blends of *cis*-polybutadiene and natural rubber, various tread formulations have been studied. The effect of sulfur level, type of accelerator, plasticizer and carbon black, and the effect of cure temperature have been investigated. In the interest of brevity data are shown only on the effect of sulfur level.

In the preliminary work sulfur levels of 1.75 or 2.0 phr were arbitrarily selected. This approximates the normal sulfur level used in both styrene and natural rubber tread compounds, and it was surmised that the 1:1 blend would cure similar to natural rubber or to a blend of natural rubber and styrene rubber. A systematic study was undertaken to establish the sulfur and accelerator levels for optimum physical properties in *cis*-polybutadiene-natural rubber blends.

With the exception of the curative levels the recipe used for the experimental stocks was identical to that shown in Table V. Sulfur levels of 1.25, 1.75, 2.0 and 2.5 phr were investigated with variable levels of NOBS special accelerator, as shown in Table VI.

The data show that compounds having good physical properties were obtained at each of the sulfur levels studied. Of course, each sulfur level requires the selection of the proper accelerator level to give the best balance of properties. For example, the best properties appear to be obtained with the following combinations:

Sulfur, phr	NOBS Special Accelerator, phr
1.25	1.2
1.75	0.8
2.00	0.6–0.7
2.5	0.5–0.6

An examination of the stress-strain data on aged stocks indicates that the higher sulfur levels gave vulcanizates with somewhat poorer aging characteristics than were obtained using the lower levels. The 1.25 phr sulfur level, in particular, gave good aging resistance. The compounding recipe which has been used for most of the developmental work, with slight modifications, is shown in Table VII.

It has been found that delayed action type accelerators give excellent scorch resistance. Aromatic or naphthenic petroleum base oils or pine tar are very satisfactory plasticizers. Resin 731 inhibits the tendency of natural rubber compounds to revert when cured at temperatures in excess of 300°F. and consequently this material gives a good balance of physical properties in the blends; however, reversion is not a serious problem. Highly reinforcing blacks, e.g., Philblack I or E, improve the stress-strain properties and laboratory abrasion resistance of the blend stocks in the expected manner.

Service Performance

Although the relatively poor processing characteristics of Cis-4 polybutadiene tread compounds had been recognized, the preparation of retread tires was considered necessary to establish the treadwear potential of this rubber. Extensive compounding studies have revealed that higher than the normal 50 phr of black gives smoother stocks. Reduction of the stearic acid level and judicious choice of placticizer type and level also improved the processing.

In tire tests now completed Cis-4 polybutadiene and Cis-4 polybutadiene/natural rubber blend tires have been run over a quarter of a million miles. The average abrasion indices for *cis*-polybutadiene (alone)

TABLE VII—COMPOUNDING RECIPE OF CIS-4 POLYBUTADIENE-NATURAL RUBBER BLEND

Cis-4 Polybutadiene	50.0
No. 1 Smoked Sheets	50.0
Philblack O	50.0
Zinc Oxide	3.0
Stearic Acid	3.0
Antioxidant	1.0
Resin 731	5.0
Philrich 5	5.0
Sulfur	2.0
NOBS Special	0.6

compared to type 1500 styrene rubber and natural rubber are as follows (average of six tests):

	Abrasion Index
Natural Rubber	100
Cis-4 Polybutadiene	140
Type 1500 Styrene Rubber	100
Cis-4 Polybutadiene	135

The abrasion index representing the results of eleven tire tests of the blends compared with the natural rubber controls is:

	Abrasion Index
Natural Rubber	100
1:1 Cis-4 Polybutadiene/Natural Rubber Blend	114

Conclusions

Suffice it to say, Cis-4 polybutadiene has exhibited some unusual physical properties in conventional compounds. Undoubtedly, additional developments will permit further improvements in the processing characteristics, tensile properties or other features of these new polymers.

The preparation and processing of 1:1 Cis-4 polybutadiene-natural rubber blends has been shown to be feasible in the laboratory and practical in conventional equipment in the factory. Tests on retread passenger tires and factory built truck tires have confirmed the excellent service performance indicated for blends of this type compared to natural rubber.

The commercialization and utilization of Cis-4 polybutadiene in blends with natural rubber in heavy duty truck tires should materially lessen the dependence of the rubber industry on natural rubber.

ACKNOWLEDGEMENT

The author wishes to express his sincere appreciation to W. W. Crouch for his assistance in directing this program; to C. C. Biard and J. R. Haws under whose supervision much of the testing was done; and also to W. T. Cooper and N. A. Stumpe, Jr., who have worked diligently on the development of Cis-4 polybutadiene.

New Developments in Silicone Rubber

By R. M. SAVAGE

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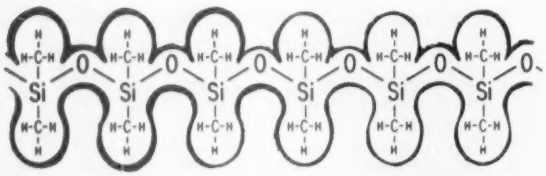
WE ALL generally agree that silicone rubber is in itself a specialty item in the rubber industry. But the subject of this paper is a special silicone rubber which we call NSR—nitrile silicone rubber.

In the fifteen years since Mr. Maynard Agens applied for his first patent on silicone rubber, the over-all silicone rubber business has grown to the point where approximately $50,000,000 worth of silicone rubber goods were manufactured in 1958. This estimate is based upon data obtained from *Chemical Week* magazine. There are three basic suppliers of the silicone gums and compounds, and numerous fabricators literally from coast to coast who are engaged in producing finished silicone rubber parts for use in many types of items and applications. As for one of the newest, it was recently announced that silicone rubber has been successfully used in one of our globe-circling satellites.

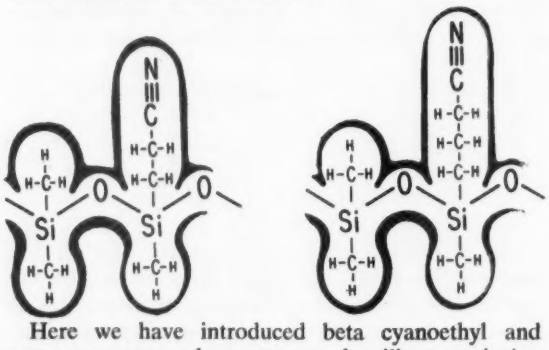
To familiarize ourselves with the structure of NSR, let us first refer to the formula of a typical silicone polymer:



In this we see the basic silicone polymer consisting of a backbone of alternate silicon and oxygen atoms, with methyl groups attached to the silicon all along the chain. Such was the nature of the early silicone rubbers in use during World War II.

Within a few years the first special purpose silicone rubbers in which there was a polymer change came along. It is an old story now that the substitution of either one or two phenyl groups for methyl groups on random silicon atoms broke up the symmetry of the molecule, thus inhibiting close packing of the molecules and further extending the low temperature limit of flexibility. It is also recognized that the presence of phenyl groups is significant in improving the radiation resistance of silicone rubber.

Following the phenyl modification, vinyl groups were added to the silicon, replacing occasional methyl groups. This resulted in special silicone rubbers with improved compression set characteristics. Another special purpose silicone rubber employing a new polymer is the Dow Corning Fluorosilicone LS-53, which is an oil-resistant stock. More recently, on August 14, 1958, General Electric announced the NSR family, whose structure is as follows:



Here we have introduced beta cyanoethyl and gamma cyanopropyl groups onto the silicon, replacing

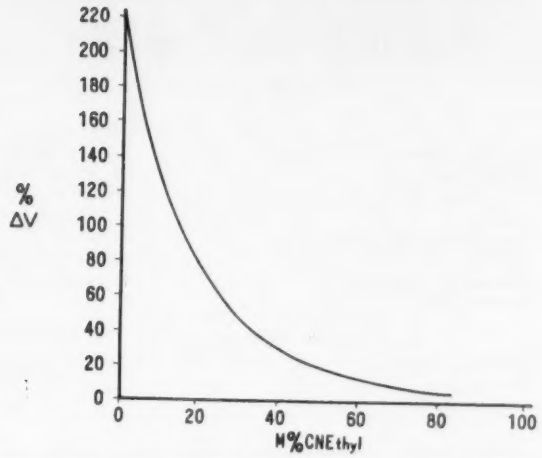
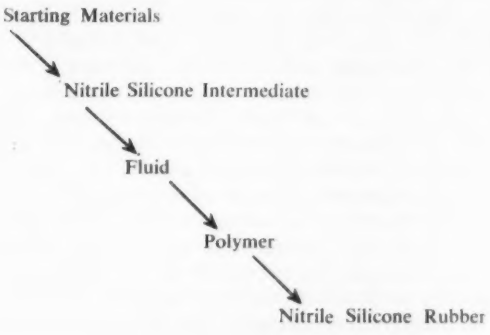


FIG. 1—Effect of cyanoethyl silicone content on swell resistance of nitrile silicone rubber (tested in ASTM Fuel B at room temperature).

occasional methyl groups. These highly polar groups have resulted in improved resistance to a number of aliphatic and aromatic oils, fuels, and solvents. They also exhibit a somewhat similar effect as the phenyl groups as regards excellent low temperature flexibility. We believe that the cyanoethyl substituted polymers are the type which offers the most promise.

The new technology which has been developed by General Electric to bring to commercial significance the NSR product line is schematically indicated as follows:



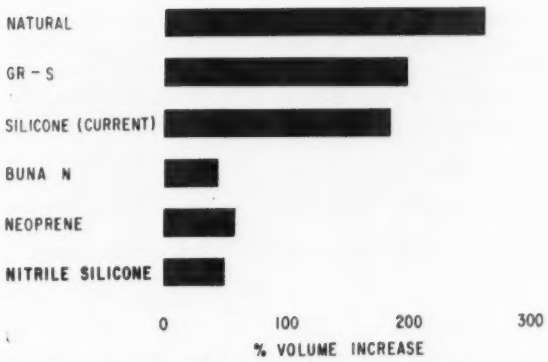


FIG. 2—Swelling of nitrile silicone rubber and other rubbers in aviation gasoline.

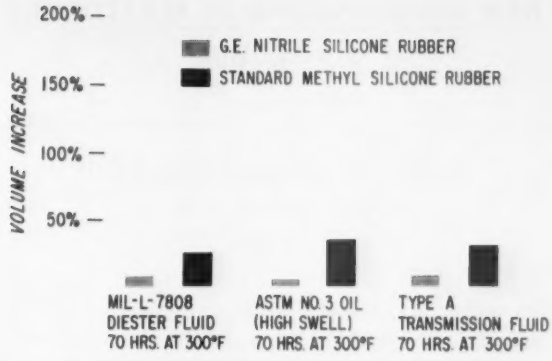


FIG. 3—Swelling of NSR and a standard methyl silicone rubber (tested in MIL-L-7808, ASTM No. 3 oil and Type A transmission fluid).

It has required research and engineering effort from the basic reaction step in making the silane, through the hydrolyzate and polymer stages, and to the finished rubber compounds.

In making the NSR polymers it is possible, by controlling the input materials and reaction conditions, to build into the structure any predetermined degree of nitrile content. This in turn will affect the solubility of the polymers, or conversely the swell resistance of finished compounds made therefrom. Figure 1 indicates rather dramatically how the room temperature Fuel B swell resistance varies with the mole per cent of cyanoethyl silicone.

The shape of this curve will vary with the solvent that is used. Depending upon the solubility parameter of the test solvent and its similarity to the solubility parameter of the nitrile silicone gums, the curve can actually show a maximum peak at some particular nitrile content. The selection of the proper level of cyanoethyl content for incorporation into the polymer is therefore dictated by many factors, including the level of physical properties needed, the particular solvent in which maximum swell resistance is desired, and the ever present economic factor.

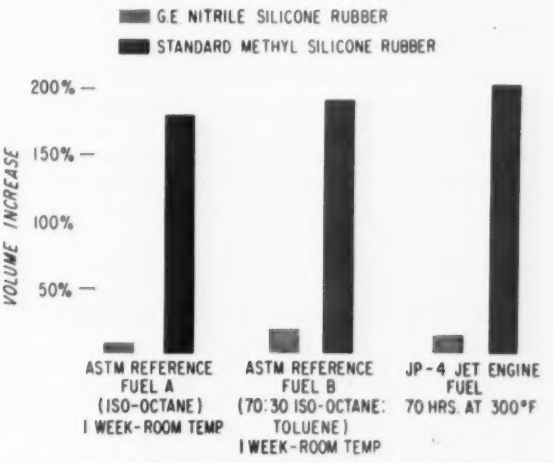

G.E. NITRILE SILICONE RUBBER
STANDARD METHYL SILICONE RUBBER
200%
150%
100%
50%
VOLUME INCREASE
ASTM REFERENCE FUEL A (ISO-OCTANE) 1 WEEK-ROOM TEMP
ASTM REFERENCE FUEL B (70:30 ISO-OCTANE: TOLUENE) 1 WEEK-ROOM TEMP
JP-4 JET ENGINE FUEL 70 HRS. AT 300°F

FIG. 4—Swelling of nitrile silicone rubber and a standard methyl silicone rubber (tested in Fuel A, Fuel B and JP-4).

TABLE I—PROPERTIES OF NSR-X8701

Cure: 16 hr. @ 450°F.

	Original
Hardness, Shore A	70±5
Tensile, p.s.i.	650
Elongation, %	125
Tear, p.i.	50
Compression Set, Method B 70 hr./300°F., %	55
Stiffness Temperature	<—90°F.
Specific Gravity	1.25
Heat aged 70 hr. @ 450°F.	
Hardness, Shore A	70±5
Tensile, p.s.i.	600
Elongation, %	100

To give a brief picture of the swell resistance of silicone rubber and of NSR, as compared to other familiar rubber polymers, Figure 2 is of interest. It shows that NSR can be formulated to give a resistance to swelling in aviation gasoline which will compare favorably with nitrile rubber and neoprene.

Now solely within the family of silicone rubbers, it is interesting to compare the relative swell resistance of NSR and methyl silicone polymers in a number of common test media. Figure 3 shows results of tests in MIL-L-7808, ASTM No. 3 oil and a Type A transmission fluid. Figure 4 tells a more dramatic story. Here we observe the effects of three fuels—Fuel A, Fuel B and JP-4, the latter tested at 300°F.

Up to this point we have discussed nitrile silicone rubber in rather general terms. I will now review some of the physical properties and immersion data which are representative of the first products which General Electric will make available for evaluation purposes. During the next few weeks you will be hearing about three new compounds. One we shall call NSR-X8701. Its initial physical properties and 450°F. heat aging properties are shown in Table I.

In Table II we see the swell resistance of this stock in a number of materials. We believe it will find application in those areas where maximum solvent resistance is desired, but where operating conditions rule out the use of other available synthetics due to either low temperature or high temperature limitations.

TABLE II—IMMERSION DATA ON NSR-X8701

	Hr./°F.	ΔH	ΔV	T	E
Fuel B	70/RT	— 8	+25	300	60
JP-4	70/300	—10	+17	380	70
ASTM #3	70/300	— 5	+ 2	...	...
MIL-L-7808	70/300	— 7	+ 8	...	...
	70/350	—10	+11	...	...

TABLE III—PROPERTIES OF NSR-X4803

Cure: 16 hr. @ 400°F.

	Original
Hardness, Shore A	80±5
Tensile, p.s.i.	850
Elongation, %	125
Tear, p.i.	75
Compression Set, Method B 70 hr./300°F., %	45
Stiffness Temperature	<—100°F.
Specific Gravity	1.4
Heat aged 70 hr. @ 450°F.	
Hardness, Shore A	85±5
Tensile, p.s.i.	700
Elongation, %	100

It is recognized that for many applications the lowest possible swell resistance in a wide range of fluids may not be desirable or may not result in the best over-all balance of properties. A typical example might be a compound designed for use in one specific oil seal problem. Table III shows the physical properties and heat stability of NSR-X4803, which we believe will be useful for transmission seals in the automotive industry in sealing against Type A transmission fluid.

In Table IV we see the immersion data for this material. Of particular interest here is the volume change after immersion in both 300°F. and 350°F. Type A transmission fluid.

The third new product in the NSR family is NSR-X5602. This stock has been designed as a 60 durometer extrusion stock for airframe seals and gaskets, where intermittent or accidental contact with high swell oils and fuels becomes a factor. Table V indicates the physical properties of this material, and Table VI shows immersion data. This product has now been introduced for market evaluation.

The volume changes shown in Fuel B and JP-4 are not as low as is obtainable in the 800 class of silicone rubbers possessing maximum solvent resistance, but for the applications which are foreseen for this stock, we believe that the stock affords a good balance of physical properties versus solvent resistance.

It was mentioned earlier that the solubility parameter of the solvent affects the swell resistance of the rubber compound. We must note from this last table that although NSR-X5602 exhibits a tremendous improvement in resistance to JP-4, it affords very little improvement in resisting the effects of MIL-L-7808,

TABLE IV—IMMERSION DATA ON NSR-X4803

	Hr./°F.	ΔH	ΔV	T	E
Type A Transmission Fluid	70/300	—15	+17	600	130
	70/350	—17	+19	400	90
ASTM #3	70/300	—14	+21	...	...

TABLE V—PROPERTIES OF NSR-X5602

Cure	1 hr./300°F.	3 hr./400°F.
Original		
Hardness, Shore A	55±5	60±5
Tensile, p.s.i.	1100	1000
Elongation, %	300	240
Tear, p.i.	90	75
Compression Set, Method B 22 hr./300°F., %		50
Stiffness Temperature	<−100°F.	<−100°F.
Specific Gravity		1.21
Heat aged 70 hr. @ 450°F.		
Hardness		65±5
Tensile		800
Elongation		190

as compared to some other low temperature stock already in use in the aircraft industry, such as SE-551. An NSR more like X8701 would be selected where this fluid is most important.

Introductory prices for these special purpose silicones, made in pilot plant facilities, will be relatively high, ranging from $12 to $15 per pound. Long term price projections will depend largely on how the market develops, as has been the case with silicone prices over the past several years.

TABLE VI—IMMERSION DATA ON NSR-X5602

	Hr./°F.	ΔH	ΔV
ASTM #1	70/300	− 5	+ 2
ASTM #3	70/300	−18	+ 20
Fuel B	70/RT	−10	+115
JP-4	70/RT	−11	+ 70
	170/300	−15	+ 90
MIL-L-7808	70/RT	−12	+ 45

You have seen that already NSR 60 durometer, 70 durometer and 80 durometer stocks are feasible, and we are submitting these compounds for industrial evaluation. We feel that though they do show significant improvements in oil and solvent resistance, they should be considered as only indicators of the family of new NSR materials to come. Progress in silicone rubber has been steady and rapid, and we trust that NSR materials will share with other silicone products this same growth rate.

ACKNOWLEDGEMENT

The author wishes to gratefully acknowledge the work of many of his associates for their respective contributions to this program, and to the data contained herein.

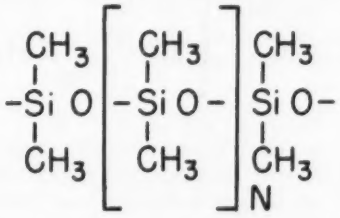
New Developments in Special Purpose Silicone Polymers

By G. M. KONKLE

Dow Corning Corp., Midland, Michigan

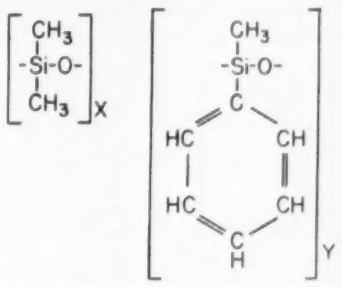
SILICONE rubber is composed of silicone polymer, filler, vulcanizing agents, and additives. Fillers are needed for reinforcement; a vulcanizer is used to effect cross-linkage; and additives can be used to obtain or enhance desirable properties. Certain properties are characteristic of the polymer, assuming that the proper types of other ingredients are used. These properties are: heat stability, low temperature flexibility, solvent resistance, weathering and radiation resistance, and certain vulcanization characteristics.

The first silicone rubbers were made from polydimethylsiloxane, which has the structure:

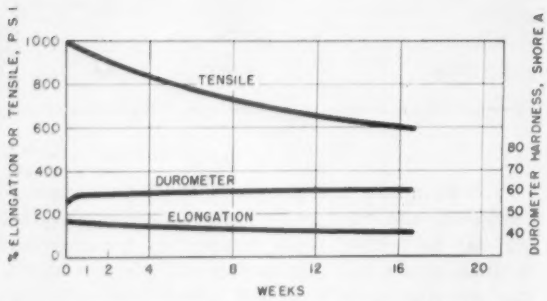


Compounds made from this polymer had good heat stability, good low temperature flexibility, and excellent weathering resistance. Their compression set was high unless additives like mercuric oxide were used. Solvent resistance was poor, and radiation resistance only fair. Vulcanization could be accomplished only by the used of active peroxides, like benzoyl peroxide, and heat.

The first change in properties obtained by polymer variation was improvement in low temperature flexibility. This was accomplished by replacing some of the methyl groups with phenyl groups, as shown below:



When 5 to 10 per cent of the methyl groups were replaced, the brittle point, as measured by ASTM D-746, was lowered from —100° to —178°F. The stiffening point of these compounds, the point at which



Dry heat aging at 392°F. of a fluorosilicone rubber (Silastic LS-53).

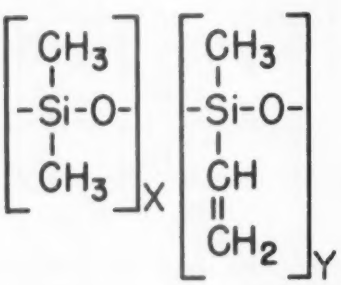
Young's Modulus reached 10,000 psi, was lowered from —65°F. to —166°F. These materials filled the requirements of the aircraft industry for rubber that would remain easily flexible at —100°F. It has been suggested that the bulky phenyl groups break up the regularity of the polydimethylsiloxane chain and lower the crystallization temperature *(1)*.

It was also found that increased phenyl content reduced flammability and made it possible to compound self-extinguishing silicone rubber. Recently, it has been shown that at an even higher phenyl content radiation resistance can be significantly improved. For instance, a silicone rubber made from a high phenyl content polymer takes five times as much radiation to reduce elongation to 50% as is required for a non-phenyl containing composition *(2)*.

The high temperature properties of silicone rubber made from phenyl-containing copolymers are equal to those made from an all-methyl polymer. There is a moderate reduction in oil resistance. The compounds from high phenyl content polymers have less desirable handling characteristics. They are generally somewhat sticky before vulcanization.

The next polymer modification of major interest was the introduction of vinyl groups. This was proposed in 1948 *(3)*, although the first commercially available compounds were not introduced until 1953.

The formula for a vinyl substituted polydimethylsiloxane is:



Such polymers, containing one vinyl group to every 500 to 1000 silicon atoms, have several unique advantages. Silicone rubber made from them has low compression set at high temperature without the use of additives. This eliminates the need for toxic additives such as mercuric oxide. Less peroxide is needed for the vulcanization of a vinyl polymer, thus reducing the amount of volatile by-products.

Certain peroxides, unusuable with non-vinyl containing polymers, give processing advantages. Either dicumyl peroxide or di-t-butyl peroxide make the oven curing of thick sections easier and faster, reduce air inhibition during molding, and can be used to cure carbon black filled conductive silicone rubber *(4)*.

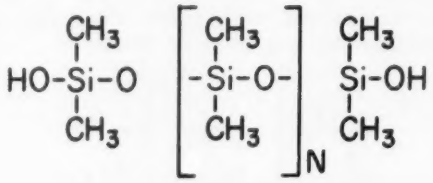
Silicone rubber with a higher vinyl content can be vulcanized with sulfur and, in many cases, co-vulcanized with organic rubber *(5)*. Most of the silicone rubber introduced in the last few years is made with a vinyl containing polymer. It thus has low compression and the ability to be vulcanized with a variety of peroxides.

The solvent resistance of silicone rubber is another property largely dependent on the polymer. It can be improved by substituting fluorinated side groups or nitrile groups for methyl groups. The extent to which solvent resistance is improved in a fluorosilicone rubber as compared to a general purpose type is shown in Table I. In aliphatic, aromatic, or chlorinated solvents the fluorosilicone rubber is much superior. In alcohol the two types of rubber are similar, and in acetone the fluorosilicone is affected much more than a general purpose type.

Fluorosilicone rubber retains the high and low temperature properties of other silicone rubber. The accompanying graph shows oven aging at 392°F. (200°C.). After 16 weeks exposure to this temperature the compound has 60% of its original tensile strength and elongation and has increased only a few points in hardness. Table II shows the low temperature properties of a general purpose polymer; a Dow Corning fluorosilicone rubber, Silastic LS-53; and a phenyl-containing rubber, extreme low temperature.

Although the brittle point of the fluorosilicone rubber is higher than the general purpose type, its stiffening point is 13 F. degrees lower. Fluorosilicone rubber is currently being used for aircraft seals in contact with fuels, oils, and hydraulic fluids.

Another type of polymer makes possible silicone rubbers that can be vulcanized at room temperature. This polymer contains hydroxyl groups:



In the presence of organo-metallic compounds these groups react with silicones containing hydrogen or alkoxy groups at room temperature and effect vulcanization equivalent to that obtained with peroxides and heat *(6)*. These compounds are sold as two-component mixes with all the organo-metallic catalyst in one component. On mixing, the two components set up to a

TABLE I—SOLVENT RESISTANCE OF SILICONE RUBBER IMMERSED SEVEN DAYS AT 75°F.

Immersant	Volume Change, % Silastic LS-53	Volume Change, % General Purpose Silicone Rubber
Iso-octane	+ 15	Over +150
Xylene	+ 19	Over +150
Carbon tetrachloride	+ 21	Over +150
Ethyl alcohol	+ 5	+ 2
Acetone	+180	+ 15

TABLE II—LOW TEMPERATURE PROPERTIES OF SILICONE RUBBER

Type	Brittle Point (°F.)	Stiffening Temperature (°F.)
General purpose	—100	— 65
Silastic LS-53	— 90	— 78
Extreme low temperature phenyl-containing rubber	—176	—166

rubber in 10 minutes to 24 hours at room temperature. The time of set-up can be varied by choice and amount of organo-metallic drier.

Room temperature vulcanizing silicone rubber is used in the aircraft industry for caulking or sealing. In the electrical field it is used for potting or encapsulating electrical equipment. It is also used as a flexible mold material.

In summary, changes in polymer composition add many useful properties to silicone rubber. Phenyl groups give greatly improved low temperature flexibility, reduce flammability, and improve radiation resistance. Peroxide vulcanization is improved by the incorporation of vinyl groups. Room temperature cure is made possible with hydroxyl groups. Solvent resistance is obtained with fluorine-containing groups or nitrile groups.

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(3) Hurd, D. T., and Roedel, G. F., *Ind. Eng. Chem.*, Vol. 40, p. 2078 (1948).

(4) Dunham, M. L., Bailey, D. L., and Mixer, R. Y., "New Curing System for Silicone Rubber," presented before Division of Rubber Chemistry, ACS (May, 1956).

(5) Polmanteer, K. E., and Koch, R. J., *Ind. Eng. Chem.*, Vol. 49, p. 49 (1957).

(6) Nitzsche, S., and Wick, M., *Kunststoffe*, Vol. 47, p. 431 (1957).

Coming Next Month...

Effects of Carbon Black on Polymers for Low Temperature Use—By Fred W. Barlow and Robert W. Cretney, Thermatomic Carbon Co., Sterlington, Louisiana
A study of the effect of carbon black type and loading on the temperature-retraction properties of five rubbers.

Liquid Urethane Elastomers—By R. J. Athey, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.
Technical data on polymers for which potential production economies and excellent physical properties forecast an important industrial role.

Vertical Continuous Vulcanization—By Ben Davis, Davis-Standard Division, Franklin Research Corp., Mystic, Conn.
Description of a new method of applying rubber insulation to wire and its advantages.

How Many Mold Cavities to Use in a Molding Operation—By William E. Kelvie, Braintree, Mass.
A simple formula provides a worksaver for the estimator.

PLUS A R/A SPECIAL INDUSTRY REPORT

Equipment Leasing in the Rubber Industry.
Facts and figures on how to acquire industrial equipment without a large capital investment.

EDITORIAL

The European Common Market and Rubber

► An outstanding group of 50 economists associated with the National Foreign Trade Council has predicted a $1.8 billion rise in United States trade with foreign nations in 1959. This group predicts that exports will rise from $16.2 billion in 1958 to $17.1 billion and that imports will rise $900 million to $13.8 billion. This statement comes on the heels of the official January 1, 1959, start of the European common market, with its 10 per cent cut in duties across the board between West Germany, France, Italy and the Benelux countries. It also follows the tremendously important move to convertibility taken December 29, 1958, by Great Britain and ten other European countries.

H. C. Bugbee, president of the Natural Rubber Bureau, points out that the start of the common market and the convertibility move have real significance for the rubber industry, not only in the very long-run future, but also directly and specifically in 1959. What might at first sight appear to be essentially a foreign exchange move of little concern to the U. S., does, on examination, become the opening of a major highway for increased American participation in Europe.

The implications for the rubber industry of these major foreign trade developments early in 1959 seem to add up to the following:

- The total European demand for rubber products will expand substantially in 1959, dramatically in 1960 and subsequent years.
- American export trade in many rubber product lines will diminish as American investments in West European manufacturing facilities rise.
- Locally produced synthetic rubber in West Europe will be stepped up at a faster rate than synthetic exports to Europe.

We agree with Mr. Bugbee that we are in a rapidly expanding world economy sure to need more total rubber and more rubber products than most of us realize. There is no room in such an era for the philosophy of restriction of production. What is needed is the greatest possible production efficiency. This applies to both natural and synthetic rubber, and to the manufacture of finished products. The emphasis must be on research for more efficient production.

What it seems to boil down to is this: Many American concerns are hedging a possible loss of export markets by investing in European concerns. Some have intimated that production cut-backs in both raw materials and in finished rubber products are inevitable. It is strongly felt in many quarters, however, that more efficient production methods can enable the U.S. rubber goods manufacturer and synthetic rubber producer to continue his exports to foreign markets at a profitable level. The facts of the situation must be faced. Unless the American manufacturer takes concrete measures now, he will lose export business later.

Special Industry Report

How to handle

Employee Grievances

RUBBER plants, like all others, have the personnel problems encountered in today's complex industrial operations. Not the least of these is the dissatisfaction of the individual employee over some matter, which though small in itself, has a determining influence on his attitude toward his work and toward his employer. Morale has always been a problem in employee relations, but under the strain of today's pressures, it seems more important now than ever.

The manager of the average rubber plant probably feels that life would be a great deal easier if employee grievances did not exist. On the other hand, it would probably be a great deal more boring, too. Every time an employee comes with a complaint, the dynamics of human relations come into play and the plant manager is faced with the creative task of handling a personnel problem to the best of his ability.

It does not need pointing out, of course, that even in the best managed plant with a detailed procedure for taking care of grievances, that there are still a thousand and one little things which can and do happen that are not covered by ordinary routine. These little discontents, seemingly petty sore spots, can fester into serious wounds and cause great trouble in the harmonious operation of the business.

There is no magic wand which will solve all the problems connected with employees' grievances. But J. E. Bedford, Professor of Management at Armstrong College, recommends a simple formula for handling them which takes out a lot of their grief. It is easy to follow, easy to remember, and easy to apply. Its three simple steps are: (1) Cry, (2) Listen and (3) Smile.

Cry

When an employee has a grievance, it is a real problem to him. Regardless of how trivial it may seem to anyone else, to him it is important. It is his complaint and he wants action—immediate and personal action.

One way to establish a working rapport with the employee is to sympathize with him—cry over his problem. This makes him feel that he is dealing with someone who understands his problem and will not by-pass it out of indifference. (A feeling of lack of understanding and indifference on the part of management is reported by industrial psychologists to be one of the major reasons for employee grievances.)

Employees with a grievance are not too sure of themselves. They tend to have a chip on their shoulders and to assume an antagonistic attitude at the slightest provocation. Approaching the employee with a sympathetic ear will ease the tension.

Then, too, an employee who has found a friendly ear will talk more freely. As he talks to a friend he reveals the true cause of his grievance. This makes it easy to follow the second step of the grievance handling formula.

Listen

During a discussion of the grievance with the employee, it is possible to arrive at the "real" cause of the complaint, determine a solution, and to develop a plan for presenting the solution. All it requires to handle this step is to listen . . . listen attentively.

As the employee with the grievance talks, he will elaborate on each point. This will give good clues to the real cause of his discontent. With all of the facts of the case out in the open, it may be possible to avoid a repeat of this same dissatisfaction with other employees.

For instance, the employee's grievance may be about his supervisor. He wants a change to some other work. When top management listens to the complete story, it is possible to get the true cause—why the employee does not get along with his supervisor—out into the open for discussion.

This makes it possible to correct the cause if it is the foreman's attitude. If some definite action is taken to make the supervisor aware of this trouble, it will avoid having the same problem come up again.

Listening attentively encourages the employee to talk more freely. When the worker does not go into detail, the listener can encourage him to give more facts. One way to get the needed information is to look at the employee registering the grievance with a questioning glance that silently says, "Yes, go on . . . . ."

When the questioning pause does not get the worker to talk freely, it is possible to use still another effective technique. This strategy smokes out the true reason by asking the employee one question, "Yes, and . . ."

Smile

This is the crucial point in handling the employee's grievance. The employee feels that at last he has found a real friend. He has talked out his problem with someone who has been listening. He is ready for action.

By smiling, the listener makes the employee feel he has a sympathetic friend. He is ready to accept the decision. If the smile is sincere, the employee will be more willing to go along with the final verdict about the grievance.

Smiles are good strategy. Smiles are dangerous, too. A smile that is laughing up the sleeve at the employee will do more harm than good. A smile that looks like a pasted on grin will cause the employee to change his attitude about the grievance handling and to be more demanding.

Smiling is easy if the first two steps of this formula for handling employee grievances have been accomplished in a friendly, sincere manner. It is a reflection of the attitude of the representative of management and leaves the employee with a pleasant feeling toward the executive level of the plant.

ASTM Committee D-11 Holds Spring Meeting in Pittsburgh

► Committee D-11 on Rubber and Rubberlike Materials of the American Society for Testing Materials held its Spring Meeting on February 4 through 6 at the Penn-Sheraton Hotel, Pittsburgh, Penna., in conjunction with the 1959 ASTM Committee Week, February 2 through 6. Subcommittee meetings of D-11 were held in the morning and afternoon on February 4 and 5 as well as the morning of February 6. Committee D-11 itself met on the morning of February 6, following subcommittee sessions. Two technical papers were given at this meeting. Cole Caryl, director of the Desert Sunshine Exposure Station, Phoenix, Ariz., spoke on "The Langleys," and A. E. Juve, director, Technical Service Research, B. F. Goodrich Co., discussed "Mooney Cure Tests for Calculating Curing Times."

Mr. Caryl, in his talk on "The Langleys," explained that the langley is the unit most widely used in pyrheliometry, the measurement of solar radiation. He discussed several exposure tests that were made of colors and plastics to record their fading and degrading in sunlight, and said that these tests showed the langley to be the most reliable unit of solar radiation measurement.

Mr. Juve stated in his talk on "Mooney Cure Tests for Calculating Curing Times," that the Mooney cure test is a sensitive and reproducible test for measuring the delayed action portion of the cure and for measuring the rate in the early part of the cure.

He presented data with which one can calculate an opproximate optimum cure for a particular stock or equivalent cure times for different stocks. He explained that because the test made involves only the early part of the cure period, it is necessary to exercise care in assuring that accurate measurements are obtained. The most common difficulty is that the viscosity curve in some cases exhibits an irregular rise due to partial crumbling of the stock, he continued.

Mr. Juve stated that in some instances when fast curing stocks are compared with slow curing stocks or when tests are run at different temperatures, the correction for time lag in attaining the test temperature becomes important. It would be desirable if the important features of the Mooney cure test, a continuous measurement as cure progresses on a single specimen of stock at the curing temperature, could be extended to an appreciably longer time, he concluded.

The Pittsburgh District of ASTM arranged a dinner on the evening of February 4, which was attended by over 100 persons and featured talks by Kenneth B. Wood, president of ASTM, and Thomas J. Gallegher, mayor of Pittsburgh. The highlight of the dinner was an address by John C. Warner, president of Carnegie Institute of Technology, whose subject was "The Fine Art of Simulation." Leland Hazard, vice-president and general counsel, Pittsburgh Plate Glass Co., served as toastmaster.

Mr. Warner explained that simulation is the art of assuming an appearance which is feigned or not true, an appearance which is meant to deceive. He described examples of its wide use in many fields of human activity, and emphasized the importance of being on guard against its effects if we are to preserve our free society.

Reports of the different D-11 subcommittees which met during the meeting follow:

Subcommittee 5—Insulated Wire and Cable (J. T. Blake, Chairman): The recent letter ballot was discussed and it was agreed that the negative ballots were not consistent with this subcommittee's other specifications and should be disregarded. A large number of minor changes in the specifications were voted. Some of these were editorial and the other changes will be letter balloted. No decision was reached as to whether cable construction D-1350 should be replaced by a much expanded one, or whether the forthcoming IPCEA would be sufficient either through dropping or replacing D-1350.

Subcommittee 6 — Packings (R. F. Anderson, B. F. Goodrich, Chairman): D. S. Messenger (Garlock), reported for the working group on Conformity of D-1147 with D-1170. A revised Table I for D-1147 was approved. It was agreed to revise paragraph 2c of D-1147 to specify a dial gauge graduated in 0.001" to measure sample thickness. A procedure for maintaining 50 to 55 per cent RH similar to that described in paragraph 6b of D-1170 was approved for inclusion in D-1147. These revisions will be forwarded to the committee for letter ballot. Recommendations to revise paragraph 7 of D-1170 to bring it into agreement with the proposed D-1147 will be made to the chairman of Section 10 of Tech A.

R. F. Fenstermacher (Keasbey and Mattison), reported for the working group reviewing the proposed specification for Flexible Watertight Rubber Type Gasket Joints for Circular Concrete Sewer and Culvert Pipe developed in Committee C-13.

It was recommended that standard RMA tolerances be employed and should apply to the actual wall dimensions of the gasket. It was also recommended that the maximum stretch of the gasket, when seated on the pipe, be reduced from 20 to 10 per cent of original circumference. Recommendations for tensile and durometer hardness were held in abeyance pending further information from the gasket suppliers. A minimum breaking strength requirement of 100 pounds on the gasket is being considered as a requirement to replace the tensile strength requirement. A durometer A requirement of 55 ± 5 is also being considered.

A conditioning period of 22 hours at 158°F. was recommended for the compression set determination tests to be run on samples cut from molded blocks. It was agreed that a seven-day oven aging period at 158°F. be recommended

to replace the proposed oxygen bomb aging requirement. The question of whether to measure tensile or elongation after aging will be held in abeyance until the method of measuring original tensile is established. It was recommended that the maximum water absorption limit be increased from 5 to 10 per cent. It was also recommended that the specification require the storage of gaskets in cartons or burlap bags, and that paragraph 10 be relaxed to make the inspection of the gaskets by the purchaser optional. This can be accomplished by substituting the word "may" for "shall."

The rewriting of paragraph 11(b) to read "Rubber gaskets shall be subject to rejection whenever they show surface checking, weathering, or other deterioration (excluding bloom) within a period of two years from date of manufacture. Gaskets or containers shall be marked to show quarter and year of manufacture. Gaskets over two years in age should be examined carefully prior to installation," it was recommended.

A report from the chairman of the study group on Gaskets and Packings was read. Replies to the questionnaire have been forwarded to ASTM headquarters for analysis.

Subcommittee 8—Nomenclature (R. G. Seaman, *Rubber World*, Chairman): The task group headed by H. Bimmerman appointed at Boston, Mass., in June, 1958, to develop acceptible definitions for rubber and rubberlike materials and elastomers, submitted its report. After much discussion in which there was evidence of wide disagreement on the proposed definitions, it was voted to refer the problem back to the same task group for more work.

B. S. Garvey (Pennsylvania Industrial Chemicals), in a letter to this task group submitted recommendations for the coding of Polyethylene, polypropelene, Hypalon, Teflon, Kel-F and Viton under the "M" family of polymers as found in D-1418.

Dr. Stiehler of the National Bureau of Standards submitted comments on Dr. Garvey's recommendations and after some discussion it was voted to appoint a task group to work on this matter and report at the June meeting.

Subcommittee 9—Insulated Tapes (C. W. Pickells, Consolidated Edison, Chairman): Mr. Pickells reported that no negative votes were received on the letter ballot covering the proposed revisions of Specifications D69, Friction Tape; D119, Rubber Insulated Tape; and D1373, Ozone Resistant Rubber Tape. These revisions have been forwarded to the secretary with a recommendation that they be letter balloted in Committee D-11.

The chairman of the task group on Water Resistant Rubber Tape has drafted a specification and has received comments from the members of the group. The specification and the comments will be sent to all members of Subcommittee 9 for further consideration. A revised draft will be presented at the June meeting. The Test Section will prepare a specification for testing semi-conducting rubber tape used in the construction of rubber insulated cable.

A. E. Juve (Goodrich), illustrating a typical cure curve of a Mooney cure test, at the D-11 Spring Meeting.

Subcommittee 10 — Physical Testing of Rubber Products (B. G. Labbe, presiding for Chairman): The sole purpose of this meeting was to reactivate the task group on the Testing of O-Rings with the idea of expanding ASTM Specification D-1414 which now covers the tension testing of rubber O-rings.

D. S. Messenger agreed to serve as chairman of the task group.

Subcommittee 11—Chemical Analyses (W. P. Tyler, Goodrich, Chairman): Progress on rubber chemical methods has resulted in submission of a method for specific gravity which is to be commented upon by this subcommittee. A few details remain to be cleared up in the method of solubility determination.

This subcommittee is working on a proposal to consolidate and clarify the methods of analysis of both crude rubbers and rubber products now existing in D297 and D833. It was recommended to D-11 that the contents of D833-46T be transferred into D297 as an additional section with the necessary revisions of content and that D833 be withdrawn as a tentative standard.

It was also recommended that this subcommittee cooperate with Subcommittee 12 concerning the location and the elimination of duplication of painting of crude natural rubber methods common to D297 and D1278.

The incorporation of D833 in D297 and the revision of titles and scopes within D297 plus the addition of new methods for zinc and titanium determination for rapid reflux methods and the addition of better methods for synthetic rubber identification and determination will be editorially handled by a task group, the nucleus of which has been chosen. The final work cannot be completed until definitions of many terms have been established by D-11.

Continued testing of methods will be carried on to implement the work of the editorial revision task group.

Subcommittee 13 — Synthetic Elastomers (B. S. Garvey, Jr., Pennsalt, Chairman): L. G. Mason of Section 1 on Sampling reported that random sampling of synthetic rubber bales for wet spots had been suggested to the task group. No action was taken, therefore, the choice of methods for sampling as covered in D-1485 will continue to be available as a referee method. A proposal for letter ballot to add sampling of black masterbatch in D1485-57T will be submitted for this subcommittee by Mr. Mason.

E. J. O'Connor of Section 2, Chemical Tests, reported next. A method for determination of oil content and total extract in oil masterbatches has been circulated in task group. Samples will be prepared with 25, 37½ and 50 parts oil and circulated for round-robin tests. Two more members will be canvassed for determination of antioxidants in oil masterbatches. APHA color test for rubbers is under consideration, but not yet verified. A method for determination of oil in oil black masterbatches has not yet been prepared. R. S. Hammer of Phillips Petroleum will canvass producers and consumers.

Editorial changes have been incorporated in Item 62 of D1416-58aT of ASTM Standards 1958, Vol. 9. Motion was carried to submit letter ballot to Committee D-11 for the following addition to Table II of D1419-58T in order to more accurately identify oil types: PAR—paraffinic viscosity—gravity constant (VGC) 0.790—0.849; NAPH—naphthenic viscosity—gravity constant (VGC) 0.850—0.899; AR—aromatic viscosity—gravity constant (VGC) 0.900—0.949; HI-AR—highly aromatic viscosity—gravity constant (VGC) 0.950 and above.

H. R. Norsworthy, reporting for the section on Physical Tests, told of the lack of an acceptable standard HAF black which has prevented tests to establish a recipe for oil masterbatches so far. Formulae for testing SBR 1502 or 1712 have been agreed upon as follows:

	parts	parts
SBR 1502	100	—
SBR 1712	—	100
HAF black	50	50
Zinc oxide	5	5
Sulfur	2	2
Santocure	1	1
Stearic acid	—	1.5

The reference Lot No. 1 of HAF black was expected by March 7th, 1959. Fourteen participants in a round-robin test will condition black one hour at 105°C. and then use the black immediately in above formulae with a freshly made reference lot of Santocure. Tensile, elongation, and stress at 300% elongation will be determined on the following cures: 15, 25, 35, 50, 70 and 100 minutes at 292°F. Results are expected before the June, 1959, meeting of Subcommittee 13.

A separate task group under G. C. Maassen from another subcommittee will submit a revision of formulae and assignment of synthetic rubbers in D15-58T.

A motion was carried to submit the following for letter ballot in Committee D-11 by the Number Assignments Section headed by Dr. Garvey: (a) The following addition to D1419-58T is to clarify assignment of numbers which identify black-polymer and black-oil-polymer masterbatches in Tables I and II. With 14 or less parts oil per hundred styrene-butadiene rubber hydrocarbon (SBR), the number will classify descriptive types as follows: 50 to 99—"Hot" black masterbatch; 150 to 199—"Cold" black masterbatch; and 1600 to 1699—"Cold" black masterbatch. With 15 or more parts oil per hundred styrene-butadiene rubber hydrocarbon (SBR), the number will classify descriptive types as follows: 250 to 299—"Cold" oil black masterbatch and 1800 to 1899—"Cold" oil black masterbatch.

The following numbers for latices were assigned and approved as of June, 1959, by Subcommittee 13 for addition to D1417-57T—Table 1:

SBR Type of Latex	Drying Aid	Drying Time (Min.)
2076		45
2107	1 Ml of	45
2108 (X765)	Distilled	45
2109	Water	45
2110		45
2111		45
2112		45

Motion was carried to approve addition of SBR 2113 latex to D1417 and D1420. Motion was also carried to approve addition of number to be assigned by Dr. Garvey in the SBR 1600 series in D1419 to cover black masterbatch of cold rubber and 50 parts EPC black as requested by Phillips.

Considerable discussion took place on a motion which lost on the replacement of the word "experimental" by the word "commercial" in paragraph 2(b) of D1419-58T as it pertains to code numbers assigned to producers of styrene butadiene rubbers in Table I. The chairman of this subcommittee will appoint a task group to recommend action at the June meeting for revision of D1419-58T.

It was noted that Subcommittee 8 on Nomenclature is taking action on assignment of code letters in D1418 for elastomers with rubberlike properties made from chlorosulfonated polymethylene and vinylidine fluoride hexafluoropropylene.

Subcommittee 14 — Abrasion Tests (R. F. Tener, National Bureau of Standards, Chairman): The results of the D-11 letter ballot on the revision of D394 and the new method for determining the resistance to abrasion of rubber soles and heels was considered. The two negative votes on D394 and four of the five negative votes on the new method were reconciled. With appropriate changes, the subcommittee recommended that the two methods be forwarded to D-11 for adoption.

Subcommittee 15 — Aging (G. C. Maassen, R. T. Vanderbilt, Chairman): G. N. Vacca, chairman of the task group on Oven Aging of Plasticized PVC and Highly Plasticized Elastomers, reported that the first round-robin tests were inconclusive because of air flow variations in the various test ovens. A second round-robin is being conducted with air flow conditions and sample placement closely specified. Comments were made on ovens developed by Markus Royen of Apex Tire and Rubber Co. In these ovens special baffles are provided to control air flow, and the samples are exposed in horizontal tubes. As a result of these comments, it was decided that Mr. Royen be invited to present a paper on these ovens at the meeting in June. It was felt that Committee D-20 should be invited to the presentation of this paper and Mr. Maassen requested permission of Committee D-11 to be able to do so.

A. G. Vieth, chairman of the task group on revision of D-1149, reported that numerous people had been contacted on the Counter Current Extraction Column Method of analysis. Nine laboratories have agreed to work on the problem and columns have been sent to four of these laboratories at this time. Only one has reported on the method to date, and this report was favorable. Work will continue and more results are anticipated by the June meeting.

Mr. Norton, chairman of the task group on the Plastic Chip Method for Determining Light Source, reported that work is progressing but is not complete. Committee D-20 is also working on this problem, and it is hoped to have a final report at the June meeting.

In Subcommittee 29's meeting on February 4th it was stated that D-24 needed a specification method for the determination of staining of carbon blacks—this being the staining of white compounds when in contact with compounds containing carbon blacks. An Advisory Committee determined that this problem should be handled by Subcommittee 15 of D-11. The chairman asked for a definition of the problem and Mr. Barlow stated, "There is a benzene extraction color test now used on carbon blacks. The problem is to obtain correlation between the benzene test and actual discoloration of a white compound in contact with a compound containing carbon black."

A motion was made and passed that the chairman of this subcommittee set up a task group consisting of black producers and consumers to work on this problem.

Subcommittee 16—Classifications and Specifications of Rubber Compounds (J. F. Kerscher, Goodyear Tire & Rubber, Chairman): Two topics made up the agenda for this meeting, the prime one being a proposal for classifying or coding of rubber compounds. This was contained in a letter by Dr. R. D. Stiehler to the chairman. The second item was a report covering the current status of the "expanded tabular" system of ASTM D735 being developed by Section IV-D-3 of the SAE-ASTM Technical Committee on Automotive Rubber.

The proposal advanced by Dr. Stiehler is a basic classification or coding system consisting of five numerals wherein the first number denotes aging, the second swell resistance, the third hardness, and the fourth and fifth combined designate the desired level of elongation for a given rubber vulcanizate.

The pros and cons of this new proposal were presented in light of the existing systems. A decision of what to do was held in abeyance until the group had an opportunity to see the progress made by Section IV-D-3 of Tech A since this latter group had given previous consideration to some phases of Dr. Stiehler's proposal.

Following the distribution of copies of Section IV-D-3's minutes covering its most recent two meetings, the subcommittee learned of how this Tech A group adopted the idea of putting significance into prefix designations being proposed in its expanded tabular system. Whereas originally the "R", "SB", and "TA" were arbitrarily selected to denote various polymers, a new system has now been devised where the first alphabet will refer to a form of heat aging and the second alphabet a degree of swell resistance. By this means it is believed any polymer, whether presently available or one that may be developed in the future, would fit this system.

Basically, Subcommittee 16 appeared to be in favor of a classification of the type suggested by Dr. Stiehler and modified by Section IV-D-3 of Tech A. It was agreed that a task group of Subcommittee 16 be appointed to work with Tech A in further developing a suitable system. The chairman was delegated the responsibility of designating the individuals for this task group.

Subcommittee 17—Tests of Hardness, Set and Creep (S. R. Doner, Raybestos-Manhattan, Chairman): The fact that "raised platform and spherical presser foot" gauge, used to measure the thickness of compression set buttons in ASTM D395-55 was not clearly defined, was brought to the attention of this subcommittee. The chairman agreed to rewrite paragraph 4d and circulate his recommendation so that final action can be taken at the June meeting.

R. Shearer gave a progress report on the work of his committee, the topic being the effect of using lubricated specimens, sandpaper confined specimens and standard D-395 compression set test. Thus far, it appears that the standard method yields results as good as those suggested by England and the ISO/TC-45 groups. This working committee is also comparing molded versus cut compression set specimens and a complete report will be ready for the June meeting.

R. S. Havenhill was recently asked to write a procedure for conditioning the durometer for low temperature hardness determinations. Inasmuch as this assignment was completed, his recommendations will be circulated to all members of this subcommittee for letter ballot before the next meeting.

Section Q, Subcommittee 1 of D-20 on Plastics has written a durometer hardness test proposal combining D676 and D1484 with some modifications. The chairmen of the three subcommittees will meet to discuss this proposal before the June meeting.

Subcommittee 19—Tests for Properties of Rubber and Rubberlike Materials in Liquids (F. H. Fritz, Chairman): It was unanimously agreed at this meeting to accept the recommendations of Tech A relative to the addition of Reference Fuel C to D471. (Reference Fuel C. consists of a 50/50 by volume mixture of iso-octane and toluene.) This recommendation will be submitted to D-11 for letter ballot.

This subcommittee also agreed by a unanimous vote to ask Task Group A to define the scope of its activities as a prelude to an investigation of specific changes in procedure or testing fluids that may be necessary to "modernize" D471. The scope should include such factors as (a) maximum temperature limitations; (b) types of new test fluids required, and (c) changes in weighing procedures to facilitate accuracy. The chairman was asked to appoint a new chairman for Task Group A due to the resignation of A. C. Simon.

Several editorial changes were discussed and it was agreed to letter ballot them within the committee.

Subcommittee 20—Adhesion Tests (H. H. Irv'n, Marbon, Chairman): Comments solicited with reference to ISO/TC-45 draft proposed on the subject of rubber to metal adhesion were sent out. The ISO method and D429-56T parallel one another very closely now and we should hear further before the next meeting.

The subject of D413-39 sponsorship as well as textile, wire and cured rubber to metal adhesion testing are to be discussed by representatives of Subcommittees 21 and 20. Committee D-11 feels that minor overlaps can best be resolved in this fashion and tentative arrangements were made for a special meeting.

Steps are being taken to set up standard values for K_1 and K_2 SAE-ASTM specification suffixes. John Anderson will keep this subcommittee informed of W4 activity in this area.

Work is being continued relative to expanding the usefulness of D429 by inclusion of defined environmental expansive aspects. The task force of Messrs. Macey, Peters and Larsen hope to have something to submit to the committee at the next meeting. Mr. Macey is to pursue further a reported significant advance in non-destructive testing and check its possibilities relative to the committee's special case. The field of dynamic adhesion testing remains relatively dormant.

Subcommittee 21—Testing of Rubber and Cements and Related Products (J. F. Anderson, B. F. Goodrich, Chairman): The ultrasonic method for non-destructive testing of bonds between friction material and metals had been previously approved by resolution of the single negative vote and will now be referred to the chairman of Committee E-7 for comment. This method is intended to be an addition to D1205-53T.

Disk shear test for metal to metal bonds is still being held up pending action by Tech A. The new tension tests between friction materials and metals was not presented at this meeting because of the absence of C. R. Lupton.

Request for suggestion of standard coated fabric for use in testing seam cements will be worked into a future program, pending results of conference with K. L. Keene, chairman of Subcommittee 24.

The first report of progress by the new task group on Methods of Test of (Tire) Cord Adhesion was presented by A. E. Hicks, chairman of this group. There was evidence of enthusiasm concerning this venture. It was decided that the task group would be divided into two sub-groups, one focusing attention on textile cord and the other on wire cord and bead wire. Mr. Hicks asked George R. Harrison (DuPont), to lead the textile committee and R. H. Hertzog (John R. Roebling's Sons), to head the wire committee. Representatives of consumers will serve with each section. This type of organization was deemed to be most effective.

Subcommittee 22—Cellular Rubbers (H. G. Bimmerman, DuPont, Chairman): Several negative votes were received on the proposed closed cell vinyl sponge. A. F. Sereque was not present at the meeting, but he reported that he could reconcile these objections. When this is done and the negative votes withdrawn, the specification can be sent to ASTM headquarters for publication.

There was considerable discussion on the report given by G. H. Barnes on the urethane foam tables. This centered around concern over the grade designations being confused with those of D735. Several suggestions were made on letter prefixes and two and three digit systems for indicating the type and compression definition or indentation range. K. E. Balliet and Mr. Barnes will work up and suggest systems for sponge and foam. The chairman will discuss this matter with Mr. Catton in order to try to eliminate further conflicts.

Subcommittee 23—Hard Rubber (W. J. Dermody, Stokes Molded Products, Chairman): This subcommittee reported that Section Q of Subcommittee 1 of Committee D-20 has just completed a letter ballot on a proposed method of test for penetration hardness of plastics by means of a durometer. The proposed method, except for the sections on scope and significance and an added requirement for statistical treatment of data, is virtually a combined verbatim transcript of D676 and D1484. The significant difference between the specification proposed in D-

Rubber and Radioactivity

► A new supply of radioactive Cobalt 60 has been installed in the radiation research laboratory of the Goodyear Tire & Rubber C., Akron, Ohio, increasing the strength of the present radiation source to 3600 curies. This is a step in the company's long term plan to raise the energy level to 10,000 curies. The laboratory, first of its kind in the rubber industry, was opened two years ago with a radioactive source of 2100 curies. The additional Cobalt 60 almost doubles the original strength and will enable Goodyear scientists to make more extensive studies in the field of radiation research. Radiation specialists currently are conducting studies on damage done to various rubber and plastic products by radiation, possibility of using radiation as a means of vulcanization and as a treatment to improve products quality.

20 and the two existing D-11 durometer methods is the restriction of the proposed method to plastics, whereas D676 refers to rubber and D1484 specifically to hard rubber.

Liaison with D-20 was set up in February, 1957, to work towards standardization in physical test methods jointly applicable to both hard rubber and plastics. The present action in D-20 is, therefore, of direct interest to D-11. D-20 in June, 1957, requested joint D-11 and D-20 jurisdiction of D676, but so far as we have been able to determine, has not taken similar action on D1484. It would appear that they have now decided against a joint method in favor of unilateral action to propose a new specification duplicating the existing two. Subcommittee 23 is opposed to this.

Due to the resignation of Robert Wentland from D-11, this subcommittee now lacks liaison with D-20. Action on a replacement has been deferred to allow for the opportunity of suggesting someone from D-11 who is capable of carrying on this work.

Task Force 6 on revision of D530 has been activated with instructions in accordance with the preponderant opinions expressed in a recent subcommittee questionnaire on revision. Mr. Shore has been added to this task force replacing Mr. Wentland, and J. Smyth will become chairman.

Task Force 1 reported that in the second round-robin on ball drop impact test, they have successfully resolved the reproducibility of the test through control of variables. They have modified the method of test slightly and will draft a revision to be recommended to Task Force 6 for inclusion in D530.

Task Force 4 reviewed their tentative proposals for hard rubber grades and will continue work. Task Force 7 reported progress on revision of D639. They feel that the title and scope of this standard should be changed to include both hard rubber and asphalt composition battery containers and, with the unanimous consent of Subcommittee 23, a request was made to D-11 to authorize the inclusion of such a change in the next revision.

Subcommittee 24—Rubber and Rubberlike Coated Fabrics (K. L. Keene, U. S. Rubber, Chairman): The following action was taken at this meeting: (1) A motion was made and approved to investigate and recommend for adoption a method of determining the flame resistance of a coated fabric. This is to include classes such as horizontal, vertical and angle. A task group consisting of K. L. Winkley, chairman, J. S. Spindler, E. G. Hamway, W. H. Bryan, J. E. Norton and K. L. Keene was appointed to conduct round-robin tests and report at the next annual meeting.

(2) The chairman was authorized to submit a formal request to Subcommittee 25 asking that they assume the responsibility for recommending a suitable cold resistance test for coated fabrics. Copies of 21 different test methods now in current use for determining cold crack resistance are to accompany the request.

(3) The report on comparison of 2″ versus 12″ per minute jaw separation speed was not presented due to adverse traveling conditions which prevented the arrival of the task chairman. This work has been completed and the results will be circulated to the membership of this subcommittee along with a letter ballot.

(4) The report on the tack tear test was also not presented due to the adverse weather conditions. This work has been completed and the results will also be circulated to the membership of this subcommittee along with a letter ballot.

(5) J. E. Hovorka presented copies of 11 different test methods for coated fabrics which are in current use by the automotive industry and are not covered by ASTM test methods. Additional copies of these methods will be sent to all members who did not attend this meeting for study so that they will be able to discuss the methods at the next meeting.

Task groups will be appointed at the next meeting to investigate those methods which the subcommittee approves for consideration.

Subcommittee 25—Low Temperature Tests for Rubber and Rubberlike Materials (R. S. Havenhill, St. Joseph Lead, Chairman): ISO Low Temperature Documents—R. E. Ofner and R. Shearer presented written comments concerning the comments sent in by the United Kingdom on the following documents:

ISO/TC-45 (Sec. 248) 387 Low-Temperature Stiffness and ISO/TC-45 (Sec. 250) 389 Low-Temperature Brittleness. These comments were accepted by the group and will be passed on to ISO through I. Kahn.

ASTM D746—R. G. Dunlop reported that 11 laboratories are interested in participating in the round-robin to determine the speed of the Scott-Solenoid using the modified impact ball thrust method. Smithers Laboratories will supply blueprints to those who do not purchase the kit from Scott. W. A. Frye circulated data showing that speed variations due to push button operation could be reduced by the use of a timing relay. He also suggested the possible use of Thyraton tube firing. Messrs. Ofner and Frye were requested, if possible, to develop a method for firing the solenoid at specific points on the 60 cycle sine wave to determine its influence on velocity.

Gravity Actuation—A motion was made, seconded and unanimously carried that the chairman request D-20 to modify the writeup to allow the use of gravity or other actuation provided that the speed and other requirements of the test are met.

The chairman was authorized to request D-20 to allow the use of the narrow straight-sided specimen as an alternate. He was also authorized to request ISO to allow use of the modified T50 specimen as alternate in ISO/TC-45 (Sec. 250) 389. These requests would bring D746 and ISO into conformance. F. Conant mentioned that their Scott-Solenoid meets the 6 to 7 foot/sec. velocity requirements and operated satisfactorily when operated at 85V.

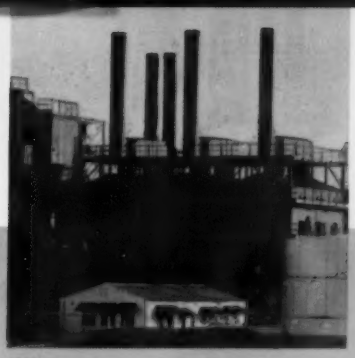
95% Confidence Limits—C. A. Steffin's request was discussed and it was decided that 95% confidence limits which would be narrow enough to be of value, could not be set up because of the wide spread in brittle temperature characteristics of certain compounds.

Coated Fabrics—Low Temperature Tests—K. L. Keene, chairman of Subcommittee 24, outlined the necessity for a standard low temperature coated fabric test. In this connection letters of C. M. Miller and G. W. Goodson were discussed. The chairman was then authorized to appoint a committee to investigate this matter, and W. H. Bryan was appointed its chairman.

Subcommittee 26 — Processibility Tests (R. H. Taylor, Scott Testers, Chairman): R. Shearer, chairman of the task group appointed to revise and combine methods D927-57T and D1077-55T, presented the first draft to the subcommittee. It was agreed that a number of changes should be made but it was also agreed that before making these changes, the revised method should be circulated to members of the subcommittee for comments. It is planned to have these comments returned to Mr. Shearer in time for the group to prepare another draft of the method for presentation at he next meeting.

J. Kirschner, chairman of the task group appointed to investigate and recommend a standard type Garvey or other extrusion die for test purposes, reported that several different dies are being used. Mr. Kirschner plans to have definite recommendations for a die and for its use by the next meeting. He further reported that the 16 points recommended by Garvey are too many and compromise recommendations will be made.

F. J. Sackfield, chairman of the task group appointed to recommend methods of test for determining shrinkage, reported that a method has been developed for determining shrinkage of raw polymers and that his group is now working on the method for determining shrinkage of compound polymers. It was agreed that the two methods should be included under one designation and it is hoped that they will



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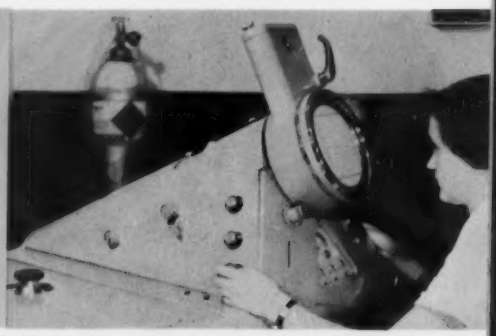

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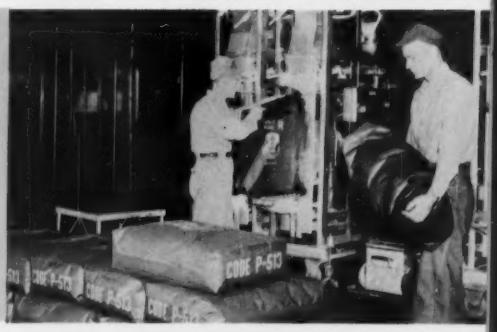

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Branch offices and agents in principal cities

be ready for presentation to the subcommittee by the next meeting.

A. E. Juve, chairman of the task group appointed to investigate the Kanavets shear plastometer to determine whether it would be worthwhile to republish information concerning it in this country and perhaps recommend its use, gave his report. His group did not recommend translation and publication of such data nor that the unit be recommended for use in this country. In the opinion of the group the alleged superiority of the Kanavets instrument is based on abnormal information from the Mooney viscometer.

Subcommittee 27—Tests of Resilience (W. A. Frye, Inland Manufacturing, Chairman): Three negative votes were received at this meeting on the proposal to change the method of computing resilience in D-945-55. These objections were resolved with editorial changes and will be submitted to D-11 for letter ballot.

Data was presented which indicated that variations in pen pressure do not significantly influence results in D-945-55. However, the chairman was instructed to canvass laboratories using the method to determine if they want to cross-test reference samples to check on inter-laboratory agreement.

Correspondence revealed considerable interest in a general method on forced vibration testing, patterned along the lines of D-832-56T. A task group, consisting of the secretary and the chairman, will draft a proposal. A question on the jurisdiction of the flexometer tests in D-623-52T was resolved after the meeting. The method was assigned to this subcommittee.

Subcommittee 29—Compounding Ingredients (A. E. Juve, B. F. Goodrich, Chairman): G. C. Maassen's task group on the rewriting of method D-15 to incorporate D1522 and to reorganize the material in a more useful way, reported on the progress of this work. The organization of the method is now well in hand and many details of the consolidation have been worked out. However, there are a number of items which cannot be finalized at the present time pending the findings of other groups working on certain aspects of the method. It is hoped that these points will be cleared up by the June meeting so that a version of D-15 suitable for letter balloting in the subcommitee will be available shortly thereafter.

The results of the work of the task group to investigate the suitability of the mixing procedures now specified in D1522 were reported. It was stated that the mill mixing procedures were adequate for all grades of black. However, the Banbury procedure which requires a nine-minute cycle followed by an eight and one-half minute finish mix on a roll mill was too long to be practical for daily use. A short, six minute mix was recommended in which both sulfur and accelerator are added in the Banbury cycle. Data on a variety of blacks by both mixing procedures was submitted demonstrating no sacrifice in reliability. The short mix, however, did result in faster scorch time and higher modulus.

A proposal by a group representing the carbon black producers made several suggestions for changes in the procedures for testing blacks. These were:

(1) To use a single test recipe for all types of blacks; (2) To use a concentration of 50 parts of black for all grades of black except the FT and MT grades; (3) To use two curing times only; and (4) To set up a reference lot of black of about 300,000 pound size to be available to all producers and consumers.

A task group was authorized to consult with the producers of the reference lot and set up a sampling plan and testing procedure for checking the uniformity of the lot and for considering the effects which storage conditions may have on the stability of its properties.

An additional task group will be formed to consider the merits and provide the supporting data for the other three recommendations of the industry group. It was agreed that as part of Mr. Maassen's revision of D-15, recipe 2A would be modified to increase the stearic acid content from 1 part to 2 parts.

Tech A—Report of Technical Committee on Automotive Rubber (H. Tangenberg, B. F. Goodrich): The following items have been approved by Tech A letter ballots: Specifications and Methods of Test on Polyvinyl Chloride Foams, Methods of Test on Urethane Foams, Specifications and Methods of Test on Automotive Air Conditioning Hose, Radial Seal Nomenclature, Fuel C, and an addition to the Automotive Gasket Materials Specification D1170. A letter ballot on the addition of Tear Values for D735 received negative votes and was not presented to D-11, but was returned to the subsection.

Items now being letter balloted include these changes in D735: the replacement of D736 by method D746 as an evaluation of the F suffix, the use of the Gehman D1053 method using a 10,000 psi maximum modulus for the stiffness suffix S, the addition of a TA-512 silicone grade to Table V, reduction of 70 hours to 22 hours for the compression set tests and the new values.

J. M. Ball, N. L. Catton, M. H. Kapps, T. Loring and D. S. Messenger were added as general interest members of Tech A.

K. Miller is the chairman of the newly organized Section 15 which deals with suspension bushings. Section 13 on standardization with reference to flash on molded goods was made inactive since their recommendations are incorporated in the SAE drafting standards. Section 10 has been reorganized—M. H. Kapps is chairman of the new Section 10 which is gaskets, R. C. Waters is chairman of Section 11 which includes subsection A on O-rings and B on oil seals.

Added to Section 4 are these subsections — D-5 Hypalon, chairman, J. P. Munn, D-6 Polyurethanes, chairman, H. H. Anderson, D-7 fluorocarbons, chairman, D. S. Messenger, and Z stress relaxation, chairman, P. Weiss.

Activity continues in all other sections with considerable progress in Coolant, Wire Braided and Power Steering Hose, Gaskets and Automotive Mats.

The extremely active section 4 classification and specifications of automotive rubber compounds under the chairmanship of H. A. Winkelmann continues to expand in new polymers, and new tests.

Subsection 4D on tables, chairman, N. L. Catton, heads the activity on new tables and the expanded tabular system.

Firestone Building Diene and Coral Rubber Plant

► Firestone Tire and Rubber Co., Akron, Ohio, is constructing what is said to be the world's first plant for the production of synthetic Diene and Coral rubbers at its Petrochemical Center in Orange, Texas. According to a Firestone spokesman, preliminary engineering work has already been completed for the plant, which will have an annual capacity of 30,000 tons of either product. As both rubbers can be produced at the same facilities, the company will be able to switch from production of one to the other as demand requires.

Diene is a partial replacement for natural rubber and Coral is a complete replacement. Diene, developed more recently by the company, is a rubber extender. Its principal raw material is butadiene, a by-product of petrochemical operations. The supply of butadiene is plentiful and initially, the new plant will produce Diene.

The company states that tire tests indicate that Diene can be used to replace a substantial portion of the natural rubber in truck tires and that it results in improved crack resistance to a marked degree; satisfactory running temperatures; and greatly improved skid-resistance due to the pliability of the materials at low temperatures.

Panel on "Plasticizers" at Southern Group Meeting

Southern Rubber Group Meets

Dallas Meeting features panel discussions on plasticizers and special purpose polymers

► Some 230 members and guests, including wives, attended the meeting of the Southern Rubber Group which was held at the Statler-Hilton Hotel in Dallas, Texas, on January 30-31. It was the eighth meeting of this progressive local group and the second since receiving official sponsorship of the ACS Division of Rubber Chemistry.

The two-day meeting featured panel discussions on "Plasticizers" and "Special Purpose Polymers," both symposiums attracting substantial attendance. In addition, the usual business meeting was held as well as the banquet which is a highlight of these meetings. As usual, a reception was held prior to the banquet, made possible by contributions received from a number of suppliers.

At the business meeting Tom Brown (Goodrich), chairman of the Nominating Committee, presented the following slate of candidates for the 1959-60 period: *Chairman*, Elden Ruch (Firestone); *Vice-Chairman*, W. H. Boettcher (Shell Oil), W. F. Gerrow (Goodyear Chemical) and Roger B. Pfau (Texas-U. S. Chemical); *Treasurer*, A. K. Remy (Mastic Tile), R. W. Rice (Firestone) and M. E. Samuels (Copolymer Rubber); *Director-Manufacturer*, R. B. Camp (Goodyear) and L. M. Everett, Jr. (Better Monkey Grip); *Director-Supplier*, L. W. McCallum (J. M. Huber) and C. W. White (Cabot Carbon). Elections will be held by letter ballot and the results will be announced at the next meeting.

Committee reports indicated that paid membership in the group had reached 436 and that the group was in good financial condition. An amendment to the by-laws was proposed under which the treasurer would be elected for a two-year term rather than one year as at present. The secretary of the group now serves a two-year term. The proposed revision will be voted upon at the next meeting.

Warren Hull (Phillips Chemical), group chairman, who presided over the business meeting, announced that the next meeting of the group will be held at the Colonial Inn, St. Petersburg Beach, Florida, on Friday and Saturday, June 5 and 6. Topics being considered for panel discussion include high speed curing and oil-black masterbatches.

Symposium on Plasticizers

The symposium on "Plasticizers" was presented on Friday, January 30, with A. K. Remy (Mastic Tile) acting as moderator. Four papers were presented, as follows:

"Plasticizer and Extender Oils: What They Are and What They Do," by Albert E. Myers (Shell Oil); "Effect of Variations in Aromaticity in Crude Rubber, SBR, Butyl and Special Purpose Polymers," by Stewart S. Kurtz, Jr. (Sun Oil); "Determination of Hydrocarbon Types of Petroleum Plasticizers and Their Effects in Rubber Compounds," by F. S. Rostler (Golden Bear Oil); "Ester and Special Type Plasticizers in Compounds Subject to Normal High and Low Temperatures," by Joe Stonis (C. P. Hall). Dr. Rostler was unable to be present and his paper was read by A. L. Robinson (Harwick Standard Chemical).

Five papers were included in the symposium on "Special Purpose Polymers," which was held on Saturday morning, January 31, with A. C. Porter, of the Convair Division of General Dynamics Corp., Fort Worth, as moderator. Titles and authors of these papers were:

"Genthane S," by O. C. Keplinger (General Tire); "Characteristics of Viton Fluoroelastomers," by Edgar Tufts (DuPont Elastomer Chemicals); "Cis-4 Polybutadiene," by H. E. Railsback (Phillips Petroleum); "New Developments in Silicone Rubber—Nitrile Silicone," by R. M. Savage (General Electric); "Silicone Special Purpose Polymers," by George Konkle (Dow Corning). Both symposiums included spirited question-and-answer periods and were well received.

(EDITOR'S NOTE: The five papers in the symposium on "Special Purpose Polymers," which included considerable new data on various elastomers, are published elsewhere in this issue.)

The banquet was held on Friday evening, January 30, in the Embassy Ballroom of the Statler-Hilton and attracted a large attendance. The convocation was read by Tom Brown (Goodrich). C. W. "Chuck" White (Cabot Carbon), group treasurer, acted as master of ceremonies and, in addition to introducing those seated on the dais, rolled off a half-dozen or so new and good stories.

The banquet speaker was Richard L. Fitzpatrick, regional sales vice-president of American Airlines, whose topic was company service. He emphasized that the taking of an order was only a promise to deliver and that the service effort put forth by all employees, regardless of rank or position, was management's prime problem. He made several suggestions for improvement of company service.

The panel on "Plasticizers," was held on Friday, January 30, and moderated by A. K. Remy (Mastic Tile). The first paper, entitled "Plasticizers and Extender Oils—What They Are and What They Do," was presented by Albert E. Myers (Shell Oil).

Discusses Composition

Mr. Myers introduced his subject with a discussion of the composition of rubber, stating that the remarkable physical properties of rubber result from the fact that it is made up of long molecules consisting of chains of carbon atoms with each carbon atom having attached to it one or two hydrogen atoms. Ultimately, these chains must be tied together with strong chemical crosslinks in vulcanizing in order to produce the strength and elasticity desired for the final product.

To do this, he said, something has to be done to soften the rubber. He discussed first the chemical softeners and then devoted the major portion of his paper to the physical softeners. After an explanation of how physical softeners or plasticizers work, he listed principal groups of physical softeners including petroleum fractions; pine products, coal tar products; natural fats and oils and their derivatives; and synthetic organic compounds.

To select a plasticizer for a given purpose from this array of products, two important variables must be considered including polarity and molecular weight or viscosity. He felt that the minimum tolerable polarity would be the compatibility limit for the rubbers under consideration. The choice regarding the optimum molecular weight or viscosity of the plasticizers would be primarily controlled by the relative merits for the purpose intended.

Discusses Aromaticity

Stewart S. Kurtz, Jr. (Sun Oil) presented a paper on "Effect of Variation in Aromaticity in Crude Rubber, SBR, Butyl, and Special Purpose Polymers." According to the author, in order that rubbers shall have adequate flexibility and elasticity, it is necessary that the chains or segments of the chains shall not be appreciably crystallized, and that there should be an adequate amount of soft polymer or oil to serve as an internal lubricant between chains. Selection of the right oil to use in preparing oil-extended rubber is an important one, the author stated.

He then discussed the composition of petroleum oil and afterwards, the increasing aromatic content of these oils. Two things, he said, must be kept in mind: the weight or volume per cent of the total oil which will be classed as aromatic because it contains at least one aromatic ring per molecule, and the per cent of carbon atoms that exist in aromatic rings.

Mr. Kurtz then discussed process oil in SBR rubber in terms of processibility; color; stability of uncured oil extended SBR rubber; and low temperature properties. Afterward he described the effect of aromatics on special rubber including butyl, WHV neoprene, nitrile rubbers and polyvinyl chloride.

Concluding his talk, Mr. Kurtz said that the increase in aromaticity of process oils improves processibility of SBR rubber. Improvements in Banbury mixing are, however, reducing the commercial importance of this difference in processibility. Highly aromatic oils are more susceptible to oxidation than less aromatic oils and are to be avoided where best color and best oxidation resistance are desired. Increase in aromaticity gives less desirable low temperature properties. Highly aromatic oils are, however, a necessity in extending WHV neoprene, NBR rubber or in plasticizing polyvinyl chloride. Paraffinic oils are preferred in butyl rubber.

"The Determination of Hydrocarbon Types of Petroleum Plasticizers and their Effect in Rubber Compounds," which was prepared by Dr. F. S. Rostler (Golden Bear Oil), was presented by A. L. Robinson (Harwick Standard). According to the author, the objective of the problem was to establish determination of hydrocarbon type; determination of the factors governing the behavior of petroleum products in rubber; and the means to correlate the two. Petroleum chemists, he said, use three different approaches to characterize products by hydrocarbon type. These are their origin, their physical constants, and their chemical characteristics.

Dr. Rostler devoted most of his paper to the third approach, the "Definition of Hydrocarbon Type by Chemical Methods." He felt that this was the best and most meaningful approach since the products under consideration are to be used as chemicals. This approach is practiced by classification, by analogy, and by classification by chemical reactivity.

The author felt that classification by chemical reactivity would be preferable since it is simple, direct and operative, and avoids investigations of questions which do not pertain to the problem at hand. In his company's method of defining hydrocarbon types, the author stated, the term "acidaffin" which was coined some 20 years ago, was preferred for describing portions of petroleum now being spoken of as "aromatic." The word means "having affinity for sulfuric acid" and thus strictly defines the fractions. It does not imply anything about chemical structure which might be confusing or misleading.

Summarizes Findings

He then gave a brief summary, which stated what this method of approach permits researchers to postulate regarding chemical nature and structure of hydrocarbon types and what has been proven experimentally to hold true regarding predictable performance. He gave chemical information and compounding characteristics for Asphaltenes; Nitrogen Bases; First Acidaffins; Second Acidaffins; Paraffins; Value $\Delta n_D SH$; and Viscosity. At the end of the paper, the speaker presented 18 slides illustrating data and points discussed.

J. E. Stonis (C. P. Hall) presented "Ester and Special Type Plasticizers in Compounds Subject to Normal, High and Low Temperatures." Mr. Stonis said that plasticizers must improve mixing and aid processing and impart specific properties that are required for use in service. The use of ester type plasticizers in rubber compounding is steadily increasing, he said, but should be used when commonly used softeners and process oils will not impart the desired properties.

The author then discussed these plasticizers in terms of their ozone resistance; heat resistance and low temperature; low water absorption; flame resistance; adhesion; chemical resistance; extraction and evaporation. These plasticizers, he said, are most commonly used in the category of mechanical goods including belts, hot service; belts, low temperature; hose, heat service; hose, low temperature; wire and cable; and gaskets, seals and O-rings.

Cites Ester Plasticizers

Ester type plasticizers, he said, are used very little in natural rubber and with limitations in SBR, where exceptionally low temperature flexibility and non-extractivity are required. They are also used in many recipes for neoprene and in fair amounts in butyl. In Hypalon, ester type plasticizers are used for both low temperature and heat resistant properties. Nitrile type rubbers having only fair low temperature properties require considerable amounts of ester type plasticizers. Mr. Stonis closed his talk with a listing of a few examples of the effect of ester type plasticizers on nitrile stock.

Guest speaker R. L. Fitzpatrick addressing the Southern Rubber Group banquet.

William W. Scull

Promoted By Goodrich

► William W. Scull has been elected vice-president, manufacturing, for the B. F. Goodrich Co., Akron, Ohio. He has been with the company since 1929. A graduate of Cornell University, Mr. Scull served in the company's Purchasing and Sales Divisions until World War II, when he was named chairman of the rubber industry purchasing committee responsible for obtaining materials to build and equip the rubber-making plants in the government rubber program. In 1944, he became manager of the man-made rubber plant in Port Neches, Texas, later becoming manager of a similar plant in Louisville, Ky. In 1945, he attended Harvard Business School and in 1946, became production manager of all plants operated by B. F. Goodrich Chemical Co., a division of B. F. Goodrich Co. He was named general manager of manufacturing services of company plants in Akron, Ohio, in 1947. In 1954 and in 1955, he served as an advisor to the U. S. State Department Rubber Study group in meetings held in Ceylon and Liberia.

Mr. Scull is president of B. F. Goodrich Malaya, Inc., a natural rubber latex processing company in Malaya and Singapore, and president of B. F. Goodrich Liberia, Inc., the company's rubber plantation operation in Africa. Serving as director of manufacturing services since 1954 and director of purchasing and traffic since 1952, Mr. Scull will continue to have responsibility, at corporate staff level, for purchasing, traffic, raw materials planning, engineering design and construction, machine development, time study and methods, industrial engineering and safety.

► National Chemical and Plastics Corp., Baltimore, Md., has announced the appointment of Chemicals and Pigments Corp., Newton, Mass., as its exclusive representative in the New York area.

Alcoa To Acquire Rome Cable

► Aluminum Co. of America, Pittsburgh, Penna., plans to acquire Rome Cable Corp. by the exchange of 355,226 Alcoa shares for the properties of the Rome, N. Y., electrical cable manufacturer. Agreements reached between the two concerns will permit distribution to Rome shareholders of three shares of Alcoa common stock for each five shares of Rome common, according to Frank L. Magee, president of Alcoa, and A. D. Ross Frazer, president of Rome. If Rome stockholders approve the agreement at a meeting to be held on March 25, it will become effective immediately, according to the company.

Acquisition would involve about $29.9 million in Alcoa stock based on the closing price of $84.25 a share on January 22 on the New York Stock Exchange. Mr. Magee, president of Alcoa, said that the company has emphasized bare aluminum power transmission cable and has been offering a limited line of insulated aluminum conductors. Rome Cable's facilities for the production and sale of many types of insulated wire and cable as well as bare copper conductors are expected to complement Alcoa's facilities.

Founded 23 years ago, Rome Cable makes a broad line of wire and cable products, chiefly of copper, steel conduit and other wiring systems. The companies plan to combine their electrical conductor, conduit and accessory activities in a new firm, to be called Rome Cable Co. Members of the Rome Cable management will continue in their present capacities.

Texas-U.S. Elects O'Keefe

► Texas-U. S. Chemical Co., jointly owned by the Texas Co. and U. S. Rubber Co., has announced the election of Arthur O'Keefe as president, succeeding William P. Gee, who has been named to the new post of vice-president in charge of foreign petrochemicals for the Texas Co. Mr. O'Keefe has been with the Chemical Division of U. S. Rubber since 1940.

Correction

► In the February issue of RUBBER AGE, the caption under a photograph of John Gifford, speaking to members of the Spanish Industry Study team, inadvertently identified Mr. Gifford as president of the Witco Chemical Co. Mr. Gifford is actually technical director for the company and, of course, Max Minnig is president. We regret the error.

Ferd Muller

Appointed Sales Representative

► Falls Engineering and Machine Co., Cuyahoga Falls, Ohio, has appointed Ferd Muller as its engineering sales representative in eastern United States. Mr. Muller will devote his time to the company's roller die cutters, servicing the New England states, New Jersey, eastern New York and eastern Pennsylvania. He formerly was with Walter Kidde & Co. for 15 years as manager of textile machinery and manufacturing supervisor. Mr. Muller recently established his own office in Montclair, N. J., as a manufacturers' representative and technical consultant, and also represents the C. A. Litzler Co. He is a member of the American Society of Mechanical Engineers and The Wire Association.

Kelly-Springfield Elects Newman

► George B. Newman has been elected president and chief executive officer of the Kelly-Springfield Tire Co., Cumberland, Md., succeeding Edmund S. Burke, who has been elected chairman of the board of directors. Mr. Newman attended Oregon State University and was associated with Goodyear Tire & Rubber Co. for more than 25 years before joining Kelly-Springfield in 1954 as assistant to the president. He was named vice-president in 1955 and appointed executive vice-president in 1957. Mr. Burke's experience in the rubber industry dates from 1911. He was named president of Kelly-Springfield in 1935.

Yellow Pigment Available

► Pigment, Color & Chemical Division of Sherwin-Williams Co., Chicago, Ill., has announced the availability of a clean primrose shade yellow pigment. According to the company, the pigment "Strontium Chromate 12170", because of its excellent light and heat resistance, is widely used in polyvinyl chloride resins to produce pastel primrose yellows.

Northern California Group Hears Estrada And Tervay

► Over 50 members attended the January 8 meeting of the Northern California Rubber Group at the Elks Club, Berkeley, Calif. The meeting featured the installation of the group's 1959 officers. Following the business meeting, a technical session was held during which Neal Estrada (Reichhold Chemicals) discussed "Resins and Rubber" and Julius Tervay (Wyandotte Chemicals) described "The Use of Specialty Chemical Compounds for Metal Preparation, Bonding and Mold Cleaning."

Officers installed were: *President,* Drace Kutnewsky (Burke Rubber); *Vice-President,* Claude Corkadel (Oliver Tire & Rubber); *Secretary,* Ray Brown (Burke Rubber); *Treasurer,* Joseph Mattson (Witco Chemical); and *Directors,* Keith Large (Oliver Tire & Rubber), Vic Carriere (Pacific Tire & Rubber) and Virgil Price (Burke Rubber).

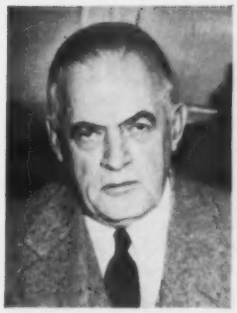
In his talk on "Resins and Rubber," Mr. Estrada told how some of the current synthetic resins resemble rubber and how they may be used to replace rubber in certain applications. In paints, for example, the high styrene SBR latex paints which accounted for nearly 70 million gallons last year representing some 65 to 70 per cent of the latex paint market are receiving more competition from polyvinyl acetate, acrylics and polyvinyl chloride, he stated. According to Mr. Estrada, the polyester type accounted for between 20 and 25 per cent of the market last year and should achieve a more favorable distribution in the future if the now attractive price structure holds.

Mr. Estrada pointed out that the polyvinyl acetate latex paints are more versatile than either SBR or acrylic types in that they are excellent for both interior and exterior applications. SBR finds little use as an exterior paint owing to its poor oxidation stability, he reported. For applications other than paints both PVC and PVA offer many advantages over SBR, he stated. These rubbery resins can be reinforced with fibers, filaments and even glass to give specialty products of superior performance, he concluded.

Mold Cleaning Methods

Mr. Tervay described the newer methods of cleaning molds and preparing metals for bonding to rubber in his talk "The Use of Specialty Chemical Compounds for Metal Preparation, Bonding and Mold Cleaning." He stated that many of the problems associated with both ferrous and non-ferrous metals can be solved with alkaline type cleaners such as certain alkali metal phosphates. Water rinsable solvent cleaners such as chlorinated or ammonia based materials are safe for all metals, he declared, but are neither as economical nor as effective as certain other types. One method used in mold cleaning involves the use of direct current for several cycles followed by an alternating current, he explained.

Ultrasonic cleaning can be used where the mold contains holes or crevasses which cannot be reached by ordinary methods, he said. In preparing the metals for bonding, alkaline cleaners plus an electrical current are best, he pointed out. However, certain reagents such as Phosphorite or Cupridine also make excellent surfaces for steel, aluminum, zinc or galvanized metals. No special equipment is necessary and corrosion is not a problem in using these chemicals, he concluded.



G. L. Abbott

R. M. Waples

A. J. McMullen

Garlock Appoints Three Executives

► Garlock Packing Co., Palmyra, N. Y., has named A. J. McMullen, formerly a vice-president, as president and principal executive and administrative officer of the company. Robert M. Waples, formerly president of the firm, has been elected chairman of the board, succeeding George L. Abbott, who has retired as board chairman. Mr. Abbott will continue as a director and chairman of the executive committee. Mr. McMullen, who has been associated with the packing industry for many years, had previously served as president of the United States Gasket Co., Camden, N. J., and continued in that position when United States Gasket was acquired by Garlock in 1955. Later that year, he was elected a director and vice-president of the parent firm.

Mr. Waples started with Garlock in 1915 and in 1927, he was named manager of the Sales and Service Division at Palmyra. He was elected secretary in 1929, vice-president in 1948, executive vice-president in 1952, and president in 1955. Mr. Abbott joined Garlock in 1911 and subsequently became a director, general manager and vice-president. He was named president in 1928 and continued in that capacity until 1955, when he was elected chairman and chief executive officer.

Entering Polyurethane Field

► B. F. Goodrich Chemical Co., Cleveland, Ohio, has announced that it is entering the polyurethane field through the manufacture of a new rubbery plastic called "Estane VC." According to Goodrich, the new material, being produced on a semi-commercial scale at its Avon Lake, Ohio, plant, offers high tensile strength, solvent resistance, low air permeability and abrasion resistance.

Two New Goodyear Synthetics

► Chemical Division of the Goodyear Tire & Rubber Co., Akron, Ohio, has introduced two new synthetic rubbers extended with 50 parts oil and said to be processed easily on standard rubber processing equipment. The company states that "Plioflex 1713" and "Plioflex 1714C" answer the rubber industry's need for synthetic rubber extended with more than the usual 37½ parts of oil.

Plioflex 1713 is a non-staining, non-discoloring cold rubber extended with 50 parts of naphthenic type oil. It is said to provide light color characteristics similar to that of another Goodyear rubber, Plioflex 1502. It was designed for us in heels, soles, toys, flooring, sporting goods and other applications where light color and low cost are important.

Plioflex 1714C is a cold rubber extended with 50 parts of a highly aromatic oil. It is a staining type of rubber which plasticizes efficiently and gives maximum processing and physical properties at minimum cost. Stabilized with Goodyear's recently introduced Wingstay 100, it has excellent raw polymer stability and high resistance to ozone and oxygen, Goodyear states. It was designed for use in tires, camelback and mechanical goods.

Akron Holds Symposium On New Elastomers

Speakers offer comprehensive talks on some newly developed polymers

► A "Symposium on New Elastomers" was conducted at the winter meeting of the Akron Rubber Group, Inc., which was sponsored by the Division of Rubber Chemistry of the American Chemical Society, and held at the Sheraton Hotel in Akron, Ohio, on January 23. Dinner was served following the technical session and later, Dr. Kenneth McFarland, educator and humorist, addressed the group on the subject of "Three Dimensional Confidence." Another feature of the dinner meeting was a report by George Hackim (General Tire), who spoke for the nominating committee.

Those whose names were submitted by the nominating committee were: *Chairman,* Milton Leonard (Columbian Carbon); *Vice-Chairman,* Irvin J. Sjothun (Firestone) and Robert B. Knill (Goodyear); *Secretary,* John Gifford (Witco Chemical) and George Popp (Phillips Chemical); *Treasurer,* Victor F. Springer (Goodrich) and Charles W. Stalker (General Tire).

Halogenation of Butyl

J. R. Davis (DuPont) presided over the symposium, which was held at 3 p. m. The first paper at this session was entitled "Halogenation of Butyl Rubber," by Richard T. Morrissey (Goodrich). According to Mr. Morrissey, the importance of butyl has been recognized for many years in the rubber industry and its unique properties have recommended its use in many products. However, he said, there has been a need for improvements or modifications of butyl rubber. Desirable improvements would be a faster rate of cure—comparable to other rubbers; development of a satisfactory cure in mixture with natural and synthetic rubbers; and adhesion to other rubbers and metals. The second item includes the problem of contamination, which has made it necessary to keep butyl stocks separate from other rubber compounds.

Halogenated butyl polymers were discovered as a result of an intensive effort to improve these properties of butyl rubber. Bromine appears to be most effective in producing all of the desired improvements. Halogen halides, such as iodine monochloride, have produced polymers with properties close to those of brominated butyl. Chlorine causes some degradation of butyl in higher concentrations. However, in the lesser amounts, chlorine produces modifications which have partially approached those obtained with bromine. Fluorine appears to be too reactive in its reaction with butyl and apparently breaks the polymer chains and reduces its molecular weight. Fluorinated butyl rubbers have shown low tensile strengths. In contrast to fluorine, iodine reacts very slowly and polymers prepared with an excess of iodine plus a catalyst still contained only a small amount of combined halogen. Slightly iodinated polymers showed no improvement over butyl with regard to curing with natural rubber or to its adhesive properties.

Halogenated butyl polymers have been prepared by several methods. One of these methods involved dissolving butyl in an appropriate solvent such as benzine, heptane, ethyl or methyl chloride. Halogen, either as a liquid or gas, is added to the butyl cement. A caustic solution is then added to neutralize excess halogen. Following completion of the neutralization reaction, a stabilizer such as calcium silicate or an epoxy compound may be added. The polymer can be coagulated by adding the halogenated butyl solution to a non-solvent such as alcohol or water. Another method involves adding a halogenated agent such as N-bromoacetamide to butyl on the mill. Halogenation of the polymers may then be accomplished by the proper application of heat.

Mr. Morrissey, summarizing results of experiments, stated that butyl rubber has been modified by reacting the polymer with halogen. The reaction has been considered as mainly addition of the halogen to the double bonds, thereby lowering the unsaturation. Both sulfur and bivalent metal oxides can serve as vulcanizing agents for halogenated butyl and both may function in the same compound, thus producing a faster cure rate as compared to butyl. The bromo and chlorobutyls can also be covulcanized with natural rubber and SBR, and therefore, it is possible to impart to these rubbers many of the excellent properties of butyl such as low air diffusion and ozone resistance. Still another advantage is the good adhesion to other elastomers, metals and fabrics.

The next paper, entitled "Practical Applications of Halogen-Containing Butyl Polymers," was presented by L. T. Eby (Enjay). The author stated that the manufacture of halogen-con-

Messrs. Morrissey, Eby and Keplinger are shown standing behind seated panel members Abernathy, Saltman, Alliger and Davis.

taining butyl rubber, results in a polymer containing combined halogen with entirely different vulcanization characteristics. In this paper, the bromine derivative was called bromobutyl, while the chlorine derivative was designated chlorobutyl. In the preferred halogen-containing polymer, Mr. Eby said, the reactivity of both the halogen and the double bond in the allylic systems provides for a broader base in compounding than is found in butyl rubber and most other synthetic elastomers.

Each application for an elastomer depends on a combination of many properties balanced so as to provide an economical product that will perform in a certain manner under a specific range of conditions. With so many variables controlling each application, one elastomer would never satisfy the rubber industry for all applications. However, a new elastomer may become a general purpose rubber if it can be produced cheaply enough and can be used interchangeably with elastomers now used in many applications.

Mr. Eby described some of the properties of bromobutyl and chlorobutyl and their suitability for various applications. Documenting his talk with a series of tables, he discussed these materials in terms of a tie-ply compound; inner liner compounds; cure systems for halogenated butyl; heat resistant applications; a curing bladder hot conveyor belt; a steam hose formulation; a food container; a ring type jar seal; a molded mechanical part with heat resistance and low tack; white compounds; and a protective black veneer.

Contribution of Genthane

"The Contribution of Genthane Elastomers to the Rubber Industry," was presented by O. Keplinger (General Tire). Mr. Keplinger opened his talk with a brief discussion of some of the characteristics encountered in polyurethanes such as abrasion resistance, durability; high tensile; excellent elongation; oil, ozone and oxidation resistance; and, in some cases, reasonably good temperature properties. He stated that rubber compounding is directed toward maximum service for a given expenditure of money. He then discussed some of the polyurethanes that have been developed, including a polymer prepared by Otto Bayer of I. G. Farben; a rubberlike cast polyurethane; the Vulkollans; Vulcaprene; millable polyurethanes; and Genthane-S.

In recent developments, he said, a new magnitude of thermal resistance has been demonstrated in experimental polyurethanes. Instead of degrading completely within a few hours, these vulcanizates retain much of their strength for long periods. According to Mr. Keplinger, peroxide cured polyesterurethane elastomer seems to have

Urethane Use Increasing

► Urethane foams have caught the interest of forward-looking small firms and initial ventures appear to be profitable, according to the *New York Journal of Commerce*. The recently pioneered material is being used, in some form, in almost all 1959 model cars. About 2½ pounds of the flexible foam per unit has been estimated as the amount of new foam in today's cars. However, the 1959 three seat Ford station wagon is said to use about 12 pounds per car.

desirable characteristics of high strength; oxygen and ozone resistance; abrasion resistance; resistance to many organic fluids; a high degree of thermal radiation stability; and unique low temperature properties. Above all, is its ease in processing in all phases from milling to extruding or calendering to its excellent mold duplications; its short curing cycles; and its freedom from scorch, both at reasonable operating temperatures and over prolonged storage after final compounding. He concluded his talk stating that advances are definitely being made in those areas of thermal and hydrolytic stability which have limited the use of polyurethanes.

H. H. Abernathy (DuPont) discussed "Fluorocarbon Elastomers—the Vitons." Mr. Abernathy said that the fluorocarbon elastomers are comparative newcomers to the field of synthetic rubbers which have gained wide acceptance as a result of the combination of heat and chemical resistance they offer. Fluorocarbon materials presently available were listed after which the Vitons were specifically discussed as outstanding examples of fluorocarbon rubbers which also typify the whole class. He then discussed Viton A and Viton A-HV in detail giving their major characteristics, properties and end-uses.

Mr. Abernathy felt that it is reasonable to expect the development of Vitons having better resistance to heat and chemicals and improved processibility. He also expected improvements in vulcanization systems and development of more effective plasticizers. As volume of use increases, he said, relative price can be expected to decrease. All of these factors added together indicate a very bright future for these polymers.

The next paper, which was delivered by W. M. Saltman (Goodyear), was entitled "*Cis*-Polyisoprene and *Cis*-Polybutadiene—Process, Catalysis and results." Emulsion systems discussed in this paper were said to be unusual in that they are able to selectively and almost exclusively join together monomer units in one well ordered form. Catalysts which give these well organized polymers are designated "stereospecific." Those catalysts that result in *cis*-polyisoprene are of great interest because natural rubber is *cis*-polyisoprene. Of the various possible polybutadienes, the one which appears most likely to become a commercial success is *cis*-polybutadiene.

According to Mr. Saltman, processes now known for making the ordered polymers with stereospecific catalysts must take place in the absence of air, moisture and polar materials. About all that can be present are the catalyst, monomer and perhaps a solvent which is either an aliphatic hydrocarbon, like hexane, or an aromatic, like benzene.

By the use of stereospecific catalysts, he said, control of the way the polymer grows is achieved. Here, each new monomer unit fits snugly alongside the preceding one in the correct position so that the whole polymer chain is neatly ordered. It is the catalyst which does the tailoring of the polymer and the search for tailored polymers is the search for new and better catalysts. Understanding of the catalytic process is still nebulous, and selection of a catalyst for a given process is still done empirically, Mr. Saltman said. He then discussed approaches to the problem of finding a tailored catalyst.

The final paper "*Cis*-Polyisoprenes and Polybutadienes—Properties and Uses," was presented by Glenn Alliger (Firestone). According to Mr. Alliger butadiene-styrene is the only synthetic tire rubber presently produced in volume. This polymer, although outstanding as a passenger tire rubber is unsatisfactory for heavy duty tires because of its high hysteresis and poor hot tensile strength. Natural rubber, on the other hand, is outstanding in both of these properties. Natural rubber also has good building tack and good strength in the uncured state, properties which are necessary for the fabrication of large size items such as truck tires and which are not present in butadiene-styrene.

Compares Polymer to Natural

Mr. Alliger said that in their present state of development synthetic *cis*-polyisoprenes have both the structure and the quality of natural rubber and may be used to replace all or part of the natural rubber in heavy duty tires and other applications for which, at present, only natural rubber is suitable. Synthetic *cis*-polyisoprenes should be able to compete with natural rubber selling at the average price of the latter for the past three years. On the other hand, *cis*-polybutadiene rubber has potential primarily as a partial replacement for natural rubber in heavy duty tires and other items.

V. F. Giulitto

Named Senior Sales Engineer

► Goodyear Tire & Rubber Co., Akron, Ohio has announced the appointment of V. F. Giulitto as senior sales engineer in its Rubber and Rubber Chemicals Department. In this post, Mr. Giulitto will be responsible for sales service activities relating to the Chemical Division's nitrile rubber, Chemigum. He joined the company in 1951 following his graduation from the University of Akron with a B.S. degree in chemistry. In 1954 he was transferred to Goodyear Atomic Corp. at Portsmouth, Ohio, and returned to the parent company the following year. He was then assigned to product development compounding. Mr. Giulitto is a member of the American Chemical Society and the Akron Rubber Group.

Morton Chemical Elects Dabovich

► Morton Chemical Co., Chicago, Ill., has announced the election of Thomas Dabovich to the post of vice-president. Mr. Dabovich graduated from the University of Illinois College of Pharmacy in 1939, and served as a research chemist for G. D. Searle Co. until 1943, when he served as a meteorologist in the U. S. Navy. In 1946, he was western regional sales manager of Sharples Chemical Co., and in 1952 joined the J. T. Baker Chemical Co. as sales manager of the Industrial Chemical Division. In 1954, he joined the Morton Chemical Co., and served as general sales manager until being named vice-president.

Mueller Has New Address

► A. C. Mueller Co., Inc., has announced its move to new quarters located at 14625 Detroit Ave., Cleveland 7, Ohio. The company will continue to represent raw materials manufacturers as a sales agency in northern Ohio, working with manufacturers of rubber, plastics, printing ink and paint and allied materials.

USI Chemicals Promotes Knight

► Ralph M. Knight has been named manager of polyolefin planning and applications for the U. S. Industrial Chemicals Co., Division of National Distillers and Chemical Corp., New York, N. Y. Mr. Knight will be responsible for long-range planning and coordination of U. S. I.'s polymer development program and will also direct the company's Polymer Service Laboratories located at Tuscola, Ill. Since he joined National Distillers in 1953, Mr. Knight has served as polyethylene manager, polyethylene production manager and assistant to the vice-president for production.

Mr. Knight holds a B.S. degree in chemical engineering from Newark College of Engineering, where he was a member of the class of 1939. From 1939 to 1952, he was associated with the Ammonia and Polychemicals Department of E. I. du Pont de Nemours & Co., Inc., and between 1952 and 1953, he was in the Research Department of the Standard Oil Co. at Whiting, Ind. He is a member of the American Institute of Chemical Engineers, the Society of Plastics Engineers, the Society of the Plastics Industry and Tau Beta Pi.

Farrel-Birmingham Appointments

► Farrel-Birmingham Co., Inc., Ansonia, Conn., has appointed Raymond H. Perkins as West Coast manager, while G. Thomas Parker has been assigned to the staff of the company's Midwest office. Mr. Perkins, whose offices will be located in Los Angeles, Calif., has been assistant West Coast manager since 1954. He joined Farrel-Birmingham at the company's headquarters at Ansonia in 1941 and worked in various manufacturing and engineering capacities until 1948. He was then transferred to the Sales Division and served as New England sales engineer until he moved to the West Coast. Mr. Parker, who will be headquartered in Chicago, Ill., is a graduate of the University of Connecticut and has been with the company since 1956. In the February issue of RUBBER AGE, a photograph of Mr. Perkins was inadvertently identified as that of Mr. Parker. Both men, properly designated, are shown below, with Mr. Perkins on the left and Mr. Parker on the right.

Perkins

Parker

C. F. Pfeifer

Promoted by Pantasote

► The Pantasote Co., New York, N. Y., has announced the appointment of Charles F. Pfeifer as vice-president in charge of the Panta-Pak Division. Mr. Pfeifer is a graduate of the University of Pennsylvania. He served as sales manager of the Film Division, Olin-Mathieson Corp., vice-president of Jim Nash Associates, and vice-president of Standard Packaging in charge of product and package development.

Paterson Releasing Parchment

► A new type of Paterson releasing parchment, designated "Number 40-91T," has been introduced by the Paterson Parchment Paper Co., Bristol, Penna., for industrial applications where color and smoothness of the vegetable parchment are not critical factors. Paterson releasing parchment 40-91T is said to possess moderate weight and rigidity, excellent release; high strength and resistance to wetting and staining. According to the company, other characteristics include smooth fiber-free surface; fair flexibility; very good water shedding and resistance to oil and plasticizer penetration; brown color; elongation—machine direction 1.3 per cent, and cross direction 5.5 per cent; approximate tensile strength—32 pounds per inch machine direction and 23 pounds per inch cross direction.

Airlex Pilot Operations Ceased

► Latex Industries, Inc., Beaver Falls, N. Y., has announced that the company will stop pilot-plant operations on "Airlex," a plastic insoling material, because of the difficulties encountered in designing machinery for large-scale production. The company will concentrate on the development of a cellulose-neoprene combination with similar properties.

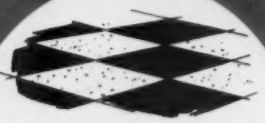
THE RIGHT RUBBER FOR THE JOB

FIRESTONE OFFERS YOU.... THIRTY-EIGHT PRODUCT-SPECIALIZED POLYMERS, LARGEST, MOST COMPLETE LINE IN THE INDUSTRY

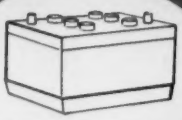
Twenty-six synthetic dry rubbers and twelve synthetic latices provide the precise product characteristics and production economies you need.

FIRESTONE SYNTHETIC RUBBER AND LATEX COMPANY
DIVISION OF FIRESTONE TIRE AND RUBBER COMPANY
AKRON 1, OHIO

FR-S 1000—An exceptionally versatile general purpose rubber. Gives very good results in most black or dark compounds. Easy processing characteristics, especially useful in making hard rubber products. Successfully used in molded and extruded goods, tire body stocks and treads.



FR-S 1001—Combines good aging properties with only slight stain and discoloration tendencies. Particularly adaptable for use in light-colored shoe soles, heels, floor tiles, moldings and extrusions. Like all FR-S butadiene-styrene polymers, it is easily processed, highly uniform.

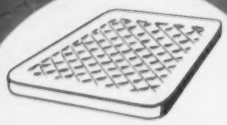


FR-S 1004—Low in water absorption and water-soluble impurities; finds special use in electrical insulation and battery cases, and in products in direct contact with food, such as can-sealing compounds and food jar gaskets. It has good physical properties and ages well.

FR-S 1006—A very light-colored non-staining polymer, ideal for white sidewall tires, floor tiles, coated fabrics, shoe soles and household goods. Requires a minimum of expensive white pigment. It lends impact strength to light colored plastics.

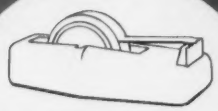
FR-S 1007—A relatively new hot rubber, characterized by low water absorption properties. It finds its widest use in electrical application—in wire and cable insulation, but is also a good polymer for a variety of hard rubber articles and gaskets.

FR-S 1009—A non-staining polymer used with other rubbers to smooth out and speed up calendering and tubing and to avoid distortion of uncured products. It increases dimensional control in the manufacture of insulated wire, hose, calendered sheet goods and coated fabrics.



FR-S 1010—A non-staining, non-discoloring rubber characterized by very low polymer viscosity. Ideal for the manufacture of chemically blown sponge, it cuts milling time, eliminates peptizing agents. Use it when the ultimate in easy processing is needed.

FR-S 1012—High polymer viscosity, combined with solubility in solvents. Widely used for asbestos sheet packing, gaskets, brake lining and high viscosity cement, it is non-staining and offers high tensile strength and high modulus when cured.



FR-S 1013—A special-purpose, high-styrene rubber used in closure and can-sealing compounds. It has a low content of water-soluble impurities, low water absorption properties and relatively high uncured strength. Produces strong adhesives and may be used in contact with light finishes.

FR-S 1014—Made with a resin soap emulsifier; offers exceptionally good tack and green tensile properties. It is widely used in adhesives, can-sealing compounds and industrial tapes.

FIRESTONE NOW OFFERS YOU 26 SYNTHETIC FR-S RUBBERS

Firestone

BETTER RUBBER FROM START TO FINISH

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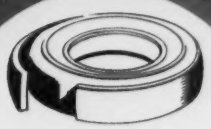
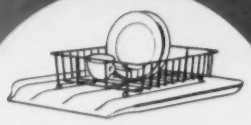
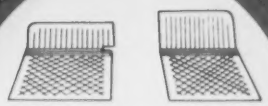


FR-S 1500—Developed from famous "cold rubber" tire tread polymers. Offers desirable physical properties, easy processing and good building tack. Used for camelback, all tire stocks, hard rubber and mechanical goods and any products requiring premium physical properties.

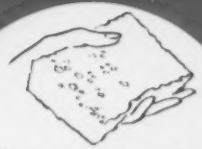


FR-S 1502—A non-staining, light-colored cold rubber; offers finest physical properties for white sidewall tires, kitchenware, hospital goods, sporting goods and coated fabrics. Its high loading capacity and desirable flex resistance make it useful for shoe soles and heels.



FR-S 1703—An oil-extended, non-staining cold polymer; ideal for low-cost rubber products like passenger car floor mats, auto truck mats, shoe soles; 25 parts naphthenic oil based on a special polymer, permits economy of manufacturing without sacrificing physical properties.

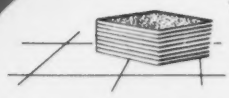
FR-S 1710—This outstanding rubber combines 37.5 parts of a non-volatile aromatic processing oil with a specially prepared polymer. Easily processed; makes for more economical compounding of camelback, tire treads, mechanical goods and molded parts.



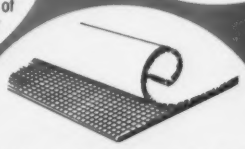
FR-S 127—A non-staining "cold rubber" with a low Mooney viscosity, ideal for chemically blown sponge rubber products. It processes easily without breakdown. It has desirable physical properties and is especially useful where high pigment loading is necessary.

FR-S 123—Features inherently superior stability; eliminates processing variations and viscosity changes caused by aging. Finds wide use in tire treads, camelback, mechanical goods and molded parts. Offers superior carbon black dispersion. Combines 31.0 parts of aromatic oil with a special polymer.

FR-S 1712—Combines a highly aromatic non-volatile processing oil with specially prepared polymer. It effects great savings in the manufacturing of tire treads, motor supports, auto insulators. Its physical properties permit use of additional oil when further cost reduction is desired.



FR-S 141—Shipped in pellet form. A master-batch of 50 parts of high styrene reinforcing resin in 100 parts of FR-S 1006, prepared in latex state. Disperses and mixes well. Useful in production of light-color rubber flooring, shoe soles or any product requiring stiffness and flexibility.



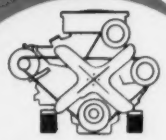
FR-S 146—Its low plasticity makes it adaptable for rapid mixing and high loading procedures. This light-colored, non-staining rubber is excellent for chemically blown sponge products, shoe soles, sporting goods, extruded items and a variety of mechanical goods.

FR-S 154—A master-batch of specially prepared polymers and 37.5 parts of a non-volatile aromatic processing oil for better extrusion control. Exceptional stability, ideal for economical day-to-day production of molded parts, mechanical goods, tire treads and camelback.

FR-S 155—Stabilized for better day-to-day extrusion control. A combination of specially prepared polymers, extended with 37.5 parts of a non-volatile aromatic processing oil. Permits great production savings for automobile windshield gaskets, camelback, motor supports or extruded parts.

FR-S 158—A master-batch of equal parts of FR-S 1502 and high styrene resin. Prepared in latex state, shipped in easily compounded pellet form; light-colored, stain-free, it is widely used in shoe soles. Imparts high impact strength to all products that can be made of styrene resin.

FR-S 173—A greatly improved polymer with respect to color, cured hardness and processibility. Used in mats, shoe soles and extruded and mechanical goods. It contains a non-staining antioxidant and 25 parts of a light-colored naphthenic oil.



FR-S 178—An economical, light-colored, non-staining rubber, extended with 37.5 parts of naphthenic oil, offers improved color, cured hardness and processing properties particularly desirable in the production of mats, shoe soles and extruded and mechanical goods.

FR-S 179—A base polymer for oil extended rubber; has extremely high viscosity. It is economical; allows compounder to add any amount of oil that best suits his process. Good physical characteristics; excellent for mechanical goods.

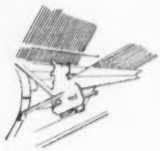
FR-S 181—A new, light-colored, non-staining and non-discoloring rubber, tailored to the manufacture of chemically blown sponge, because mixing time is reduced and peptizing agents are unnecessary. It also finds use in mechanical goods and adhesives.

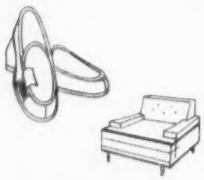
FIRESTONE NOW OFFERS YOU 12 SYNTHETIC FR-S LATICES

FR-S 2000—The most widely used latex for its economy, stability and high-tensile strength. Used for flexible, durable upholstery, textile and carpet backing. Used with resins to saturate tire cords for greater adhesion. Good for pigment and fiber binding. 42% solids.

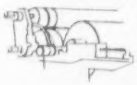
FR-S 2001—Outstanding for paper saturation in both beater and web processes. Used to increase flexibility and tear strength. Highly stable; and offers lower molecular weight for better adhesion, still retaining good tensile strength. 42% solids.

FR-S 176—A new low-cost latex for carpet and upholstery backing, saturated papers and adhesives. Highly resistant to ultraviolet light, heat aging and gas fading. Stable to mechanical action and to compounding ingredients. 46% solids.





FR-S 2002—For premium back-sizing applications requiring extra light color. Excellent for upholstery and pile carpet; will not discolor conventional dyes. Can be sulphur-vulcanized, provides flexible coatings and films with very good strength. 50% solids.



FR-S 174—A styrene-butadiene resin latex; an excellent stiffening agent for either natural or synthetic latices. For carpet backing and foam it provides increased "hand." Provides better stiffness and tear strength. 50% solids.

FR-S 2003—A high-solids latex specially desirable where light color and low cost are important. Cuts costs by improving foam compound stability. Also used as a resin and plastics additive for better strength and flexibility. 60% solids.

FR-S 151—High-tensile strength, exceptional loading capacity, high modulus with excellent heat and light resistance. Especially useful for carpet back-sizing, upholstery backing, combining compounds and adhesives. 51% solids.

FR-S 2004—A polybutadiene polymer latex which has a particular application in the manufacturing of high-impact plastics. It also is excellent for specialized latex foam uses, where color and freedom from odor are important. 55% solids.

FR-S 150—This new latex is a butadiene-styrene copolymer which is especially desirable for textile back-sizing, adhesives and pigment binding. Offers high molecular weight with good heat and ultraviolet light resistance. 51% solids.

FR-S 110—A new butadiene-styrene latex offering exceptional heat and light stability. Excellent for strong, flexible upholstery and carpet backing resistant to heat, ultraviolet light, aging and gas fading. Also excellent for high-solids adhesives. 51% solids.

FR-S 2105—A "cold" latex combining high-tensile strength with low temperature flexibility. Cuts manufacturing costs of foam products and offers excellent strength, flexibility and pigment loading capacity for backing and sizing of carpets and textiles. 62% solids.

FR-S 2006—A superior chewing gum base, this latex may also be co-coagulated with rubber pigments for dry master-batches with excellent dispersion and good processibility. Increasingly popular for asphalt paving and roofing. 28% solids.

Four Papers Presented At SPE Session On Cellular Plastics

► A technical session on "Cellular Plastics—Foams," which attracted more than 300 persons, was one of the highlights of the 15th Annual Technical Conference of the Society of Plastics Engineers. The conference, held on January 27 to 30 at the Hotel Commodore, New York, N. Y., featured the presentation of more than 100 papers at 25 technical sessions. The session on Cellular Plastics, at which four technical papers were presented, was moderated by Alan J. Breslau (Thiokol Chemical).

Papers presented were "Plastic Foams" by C. R. Davall (Union Carbide Plastics); "Glass Microballoon Spheres" by W. R. Cuming (Emerson & Cuming), H. E. Alford and F. Veatch (Standard Oil of Ohio); "The Use of Polyether Triols in Urethane Foams" by R. K. Seizinger, S. Davis, J. M. McClellan, Jr., and K. C. Frisch (Wyandotte Chemical); and "Modified Rebound Pendulum for the Evaluation of Fexible Foam Materials" by L. A. Rosenthal and G. I. Addis (Union Carbide Plastics).

Growth of Plastic Foams

A brief account of the phenomenal growth of plastic foams in the past decade launched Mr. Davall's paper on "Plastic Foams" with an examination of today's foam market. Operating on the premise that there is room and need for all of the foams, Mr. Davall gave a short description of each of them and their major areas of application. He included several comprehensive tables which provided convenient reference tools and brought together information seldom assembled in one place. The foams included in Mr. Davall's general market survey were polyethylene, vinyl, polyurethane, polystyrene, phenolic, urea, polyester, epoxy, silicone and cellulose acetate.

The paper "Glass Microballoon Spheres" was presented by W. R. Cuming. He described a new primary component for foam formulation now commercially available. This component, stated Mr. Cuming, having the form of microscopic hollow, closed glass spheres, is a free-flowing powder which can be bonded with various organic or inorganic agents to produce foams and other lightweight compositions with a wide variety of physical and electrical properties. He discussed the property in comparison with various binders and other fillers.

"The Use of Polyether Triols in Urethane Foams" was delivered by J. M. McClellan. He told about a new series of polyether triols, propylene oxide adducts of trimethylolpropane, which appear to be valuable for obtaining a wide range of physical properties in urethane foams. Depending upon the molecular weight of the triol used, reported Mr. McClellan, the resulting products range from flexible foams for the higher molecular weight members to semi-rigid foams for the lower molecular triol.

L. A. Rosenthal presented the final paper "Modified Rebound Pendulum for the Evaluation of Flexible Foam Materials." He stated that by modifying a rebound pendulum, it is possible to study in greater detail the impact properties of flexible foam materials. According to Mr. Rosenthal, the pendulum is integrated with a precision potentiometer so that angular position vs. time curves can be plotted on a recorder. Typical observed data was presented and discussed together with the operation and theory of the equipment. Lively question and answer periods followed the presentation of each paper.

Albert E. Hosier

Alvon R. Cox

Faultless Promotes Hosier and Cox

► Faultless Rubber Co., Ashland, Ohio, has announced the appointment of Albert E. Hosier, formerly director of research and development, to the newly created post of technical director for the company. Alvon R. Cox has been named to succeed Mr. Hosier as director of research and development.

Mr. Hosier is a graduate of Syracuse University, and after having been associated with Miller Rubber Co. and B. F. Goodrich, he joined Faultless in 1935. During his service with Faultless, Mr. Hosier has been responsible for a number of important contributions to material compounding and product testing. He is a member of the American Society for Testing Materials, American Chemical Society, and Alpha Chi Sigma, professional fraternity.

Mr. Cox is a graduate of Ken State University. For a period of 20 years he was associated with B. F. Goodrich Co., working in various capacities in its Technical Department. Prior to joining Faultless, he served with the Marion Division of General Tire.

U. S. Rubber Names Brown

► U. S. Rubber Co., New York, N. Y., has announced the election of Ernest G. Brown as a vice-president. Mr. Brown was formerly chairman of the Texas-U. S. Chemical Co., which is jointly owned by U. S. Rubber and the Texas Co.

Reclaimers Re-Elect Officers

► The Rubber Reclaimers Association has announced the re-election of all its 1958 officers to serve during 1959. The officers are: *President*, Thomas H. *Fitzgerald* (Naugatuck Chemical); *Vice-President*, John E. Brothers (Ohio Rubber); and *Secretary - Treasurer*, Charles T. Jansen (RUBBER AGE and ADHESIVES AGE). The association has also named Henry L. Dixon (B. F. Goodrich) chairman of the executive committee, and Chester H. Peterson (U. S. Rubber Reclaiming) chairman of the education committee.

Blaw-Knox To Buy Aetna Assets

► Blaw-Knox Co., Pittsburgh, Penna., has offered to buy the assets, exclusive of cash and receivables, of Aetna-Standard Engineering Co. of Pittsburgh. According to Aetna, the purchase price would be in cash on a basis which, based on preliminary figures, will provide about $32 a share for Aetna stock in liquidation. Based on the 507,830 Aetna shares outstanding on June 30, 1958, end of the firm's last fiscal year, this would indicate a total of some $16,250,000 available in liquidation, including cash and receivables.

Bornstein Heads New Division

► National Polychemicals, Inc., Wilmington, Mass., has announced the formation of a Plastics Division, to be headed by Dr. Leopold F. Bornstein who has been named a vice-president of the company and general manager of the new division. The company also has announced the appointment of John C. Blackwood to its executive sales staff.

Dr. Bornstein was born in Poland and received his education at the University of Prague in Czechoslovakia. He contributed greatly to the founding of the Polish plastics industry and has been active in the plastics industry in other countries throughout the world. Dr. Bornstein was previously associated with the Synvar Corp., where he served as vice-president and technical director for 16 years. He is a member of the American Chemical Society, Forest Research Society, Technical Association of the Pulp and Paper Industry and the Chemists' Club of New York.

Mr. Blackwood is a graduate of Boston College as well as Harvard Business School. He previously worked for Tennessee Eastman Corp., Hercules Powder Co. and Nashua Manufacturing Co. He also was associated with B. B. Chemical Co., and the United Shoe Machinery Corp., where he was primarily concerned with market research. Mr. Blackwood is a member of the American Chemical Society and is active in the Chemical Market Research Association.

Reynolds Chemical Completes Unit

► Reynolds Chemical Corp., division of the Stubnitz Green Corp., Adrian, Mich., has completed a new plant near Whitmore Lake, Mich., for the production of plastisol coatings and urethane foams. The unit is twice as large as facilities now operated in Ann Arbor and Ypsilanti, Mich. Other new plants, which are expected to nearly double the size of the company are in the planning stage, according to James Hull, president of Reynolds.

D. R. Alexander

Appointed To Ross Sales Staff

► David R. Alexander has been appointed to the sales staff of the J. O. Ross Engineering Division of the Midland-Ross Corp., New York, N. Y. Mr. Alexander, a 1956 graduate of the University of Maine with a B.S. degree, has been with the company's Designing Department since June 1956. He will make his headquarters at the Boston office at 79 Milk Street. This office is under the supervision of Frank W. Partsch, vice-president, and covers the New England territory for the Ross Engineering Division.

Becco Chemical Promotes Nerney

► Becco Chemical Division of the Food Machinery & Chemical Corp., Buffalo, N. Y., has announced the promotion of Frank Nerney to manager of its new southeastern sales territory comprising the states of Georgia, Alabama, Mississippi, central Tennessee and northern Florida. Mr. Nerney, a graduate of Lowell Textile Institute, started with Becco in 1938 as a research chemist. He was transferred to the Sales Department in 1949, and eight years later he was appointed technical assistant to the southern sales manager. Mr. Nerney will make his headquarters in Atlanta, Ga.

Firestone Appoints Two

► Firestone Tire & Rubber Co., Akron, Ohio, has announced the appointment of V. E. Wulff as manager of rubber purchases, and D. J. Burson as rubber buyer for the company. Mr. Wulff started with Firestone in 1925 in Malacca, Malaya, where he opened and managed the company's first branch buying office. He later served as factory manager at the Singapore grading and preparation plant and in 1940, he went to Akron as assistant manager of rubber purchases.

During World War II, Mr. Wulff was associated with the U. S. Government rubber program and was on loan to the Rubber Development Corp., going to Malaya in 1945 to aid in the procurement of rubber. He returned to Akron in 1946. Mr. Wulff is a member of the Crude Rubber Quality Committee, Rubber Manufacturers Association and an alternate member of the Advisory Committee of the General Services Administration.

Mr. Burson joined the company in 1941 in the Factory Accounting Department. He transferred to the Rubber Purchasing Department in 1945 as chief clerk and was made operating assistant in the department in 1954.

National-Standard Names President

► Thomas H. Pearce, formerly executive vice-president of the National-Standard Co., Niles, Mich., has been elected president succeeding A. H. Johnson. Mr. Johnson, who has been associated with the company for 40 years and has been president since 1952, will, with Walter H. Parkin, become co-chairman of the board of directors. William D. Peace and Richard W. Elder have been elected vice-presidents for rubber industry sales and specialty sales, respectively. Mr. Peace was formerly an assistant vice-president and Mr. Elder was general sales coordinator and manager of round wire sales. K. D. Smith has been appointed special adviser on the rubber industry.

New!— a HEAVY-DUTY PORTABLE **RUBBER STRIP-CUTTER**

EASTMAN MODEL **RS-75** STRIP CUTTER

• cuts strips 1/8" to 10" wide from slabs up to 2 inches thick and up to 95 durometer hardness

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This newly developed strip-cutter, powered by a compact one-horsepower motor, makes it simple and easy to cut perfectly square strips within .010". Blade edge and gauge are continually moistened for easy cutting. Knife is automatically sharpened while cutting. Many other fine features. Care to try this Eastman?

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Chicago Group Hears Panel On GR-S Synthetic Rubber

► Chicago Rubber Group held a technical meeting on January 30, at the Furniture Club, Chicago, Ill., at which a four-man panel spoke on the subject, "What Would You Like to Know about GR-S Synthetic Rubber?" The panel was moderated by A. E. Laurence, (Phillips Chemical) and consisted of Harold George (American Synthetic Rubber); Dr. Paul G. Carpenter (Copolymer Rubber & Chemical); Dr. A. G. Susie (United Rubber & Chemical); and W. B. Reynolds (Phillips Chemical).

Mr. George, who spoke on "Hot and Cold Rubbers," pointed out that there are 13 commonly known types of hot rubber which consist of copolymers of butadiene and styrene, and discussed their manufacturing methods. He explained both rubbers are manufactured by the same methods but in cold rubber a highly reactive chemical is used as a catalyst to permit polymerization at the lower temperature of 41° to 43°.

The next speaker, Dr. Carpenter, discussed "Oil Extended Rubbers," presenting a short history of oil extended rubbers. He then spoke about the mechanism of oil extension, the preparation of oil extended rubbers and the types of oil used, and explained some of the problems of compounding oil extended rubbers.

In his talk, "Black Masterbatches," Dr. Susie stated that black masterbatch quality has been demonstrated and there are indications that the wet black masterbatch technique can produce superior products over the standard mechanical dry mixes. There is now a trend in the masterbatch industry toward oil extended types with higher reinforcing blacks. The use of black masterbatches, he stated, result in stock cost savings through reduced mixing cycles, improvements in processing efficiencies and in plant cleanliness. Dr. Susie felt that the number of minor variations in the present black masterbatch types, and their implications, indicate to the producers and the consumers the need for standardization in nomenclature and types.

In "Recent Synthetic Rubber Development," Mr. Reynolds discussed some of the polymers now in the development stage which are ushering in a new era in synthetic rubber technology, best be characterized by the term "stereospecific." He stated that there is little doubt that important, new synthetic rubbers will come from research now being carried out on polymers of controlled structure. Stereospecific polymers are made in solution, generally with the use of solid catalysts. Considering these interesting polybutadienes and the myriad possibilities for stereospecific copolymers, it is obvious that we are on the threshold of an interesting and exciting new era of synthetic rubber technology, Mr. Reynolds concluded.

"FAULTLESS" CONTROL

system instrumented by Taylor-Emmett Controls, Inc.

The Faultless Rubber Co., Ashland, Ohio, recently installed a Taylor-Emmett control system on 22 of their presses. Small photograph shows 12 of the Taylor-Emmett ROBOTRON* Timers which control bumping cycles, curing time and press closing and opening.

This type of automatic control is new to Faultless Rubber, manufacturers of Drug Rubber Sundries, Gloves, Sponge Rubber Goods, Molded and Extruded Specialties, Foam Rubber Products. They are more than pleased with the resulting benefits:

- "Off-the-press" central control stations means more convenient access to working areas. This makes for better "housekeeping" and care of equipment.
- Press performance is now 100% predictable.
- Cycles can be set up in seconds.
- Since the entire sequence and duration of the cure is automatically controlled, each operator can handle a greater number of presses.
- Maintenance is easy, since the individual ROBOTRON Timers plug in . . . like a radio tube.

The ROBOTRON Timer is an accurate, dependable controller designed expressly for the rubber industry. Ask your Taylor Field Engineer, or write Taylor-Emmett Controls, Inc., Akron, Ohio or Taylor Instrument Companies, Rochester, New York.

*Trade-Mark

Taylor-Emmett Controls, Inc.
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Quebec Group Hears MacDonald At Combined Technical Meeting

► The Quebec Rubber and Plastics Group held its annual combined meeting with the Quebec Section of the Society of Plastics Engineers on January 15, at Ruby Foo's in Montreal. Highlight of the meeting was a talk entitled "Application of Rubber and Plastics in the Automotive Industry," given by J. C. MacDonald of the Engineering Department, Chrysler Corp. of Canada, Ltd.

Mr. MacDonald explained that in 1949, an automobile contained 374 rubber parts, including tires, in body and chassis, which weighed approximately 222 pounds. In comparison, he pointed out, the weight estimate for a 1958 car is practically identical, but the number of parts has risen from 374 to 447, a tribute to the fine engineering rubber technologists have exercised over the past ten years. Mr. MacDonald presented figures which showed that in 1958 a total of about 33,000 tons of rubber were used in Canadian vehicles, and that domestic consumption of rubber of all types, natural, synthetic and reclaim, was approximately 70,000 tons. He also pointed out that domestic use of Canadian produced rubber had been 45,000 tons.

Cites Potential Uses

Using slides, Mr. MacDonald showed where rubber parts were located in the automobile and indicated their weights. He explained that as automotive engineering advances, the need for more rubber parts increases. Functions of these rubber parts are to (1) reduce or isolate vibration; (2) seal against air, fluids, and contaminants; (3) provide electrical insulation; and (4) act as binders for friction material, adhesives, sealers and deadeners. The vast majority of rubber products perform one of the first two functions, he said.

Mr. MacDonald highlighted some of the uses, present and projected, of what are commonly accepted as plastics materials. Reviewing present uses, he stated that the workhorses of the electrical system, the phenolics, stand out. Distributor caps, coil towers, rotors, fuse retainer, wire connectors, terminal blocks and laminated insulators are possible only because properly compounded phenolics are excellent non-conductors and have excellent resistance to degradation over the range of —40°F. to 250°F. over long periods of time, even in the presence of oils and moisture. He stated that printed circuits of phenolic laminates are also a reality because of these properties.

Mr. MacDonald concluded his talk with a short discussion on the chemistry and technology of high polymers, a field which has been opened with the introduction of the "so-called" urethanes. Progressing beyond the known urethane foam parts now used in safety padding, arm rests, carpet underlays, headlinings, etc., Mr. MacDonald stated that the main effort today is directed towards the use of urethane in seating. He pointed out that although this material is not the only candidate being evaluated, it seems to be a "natural" because it can be molded to shape; its toughness allows sewing or stitching; and it may be contoured by proper heating or cutting techniques. Mr. MacDonald forecast that the consumption of plastics by the automotive industry will continue to rise, and the industry will use new polymers and compounds as soon as they have been properly evaluated for the specific applications for which they are suited.

The officers of the Connecticut Rubber Group had their picture taken with the guest speaker at the group's February 13 meeting. Left to right: A. Murdoch, Jr. (Secretary); V. P. Chadwick (Vice-Chairman); Frederick Mueller (Guest Speaker); W. H. Couch (Chairman); and F. B. Smith (Treasurer).

Connecticut Holds Winter Meeting

► The Connecticut Rubber Group held its annual winter meeting on February 13, at Rapp's Paradise Inn, Ansonia, Conn. Frederick Mueller (Thiokol Chemical), the guest speaker, discussed "Rockets and Solid Propellants."

Mr. Mueller gave a brief history of the development and manufacture of solid propellants at Thiokol, and discussed the types, advantages and disadvantages of liquid and solid propellants. He then presented a motion picture about the manufacture of case-bonded, castable composite solid rocket propellant engines. Mr. Mueller told about the factors that should be considered in the design of rocket propellant engines, such as type of thrust desired, amount of thrust desired and burning time desired. The final portion of his talk was devoted to the development of solid rocket propellant formulations, dealing with those that had greater energy content; wider range of burning rates; and better extreme temperature performance.

Sackett Joins Hartig

► Robert D. Sackett has joined Hartig Extruders Division, Midland-Ross Corp., Mountainside, N. J., as a sales engineer serving the New England and upstate New York area. Mr. Sackett formerly was technical service associate with the Plastics Division of the Monsanto Chemical Co.

G-E Realigns Departments

► A realignment of a number of departments, including an expansion of the Chemical and Metallurgical Division, has been announced by General Electric Co., New York, N. Y. According to the company, the organizational shift is designed to increase corporate efficiency, however, no physical relocation of manufacturing facilities is presently contemplated. Concurrently, the Chemical and Metallurgical Division has been transferred from its former headquarters at Pittsfield, Mass., to Bridgeport, Conn.

The following departments from the former Construction Materials Division have been assigned to the Chemical and Metallurgical Division: Conduit Products Department, Bridgeport, Conn., which also has a manufacturing plant at New Kensington, Penna.; Wire and Cable Department, Bridgeport, with plants at Lowell, Mass., and Oakland, Calif.; Wiring Device Department, Providence, R. I., with plants at Bridgeport and Norfolk, Conn., Newport, R. I., and Puerto Rico. Also assigned to the Chemical and Metallurgical Division are the sales, relations and utilities, and legal departments in Bridgeport.

Elastomer Group Hears Keskkula On Modified Polystyrenes

► Elastomer and Plastics Group of the Northeastern Section of the American Chemical Society, held a technical meeting on January 20 at the Morse Auditorium, Museum of Science in Science Park, Boston, Mass. Guest speaker at the meeting was Dr. Henno Keskkula, group leader for the Dow Chemical Co., Midland, Mich., who spoke on "Methods of Studying Rubber Modified Polystyrenes," a paper prepared by Dr. Keskkula. Co-authors, with Dr. Keskkula, of this presentation were Dr. J. A. Schmitt, J. G. Cobler and J. W. Norton, Jr.

Dr. Keskkula briefly described methods of preparing rubber reinforced polystyrenes, and pointed out the inherent difficulties in the study of these systems. These difficulties, he explained, result particularly from the fact that synthetic rubbers change considerably in their characteristics during the incorporation into polystyrene. Further, considerable grafting of styrene into rubber hydrocarbon backbone occurs when rubber is dissolved in styrene, followed by polymerization.

Short time stress relaxation data on several polymers were given. According to Dr. Keskkula, the data can be used to show the critical crazing stress and strain on opaque materials where standard critical elongation measurements fail. Further stress-strain plots were shown, obtained at 300 inches/minutes extension rates. He reported that flexural high speed experiments showed that considerable anisotropy exists between specimens obtained perpendicular and parallel to polymer orientation, and that the perpendicular flexural extension at failure can be correlated with a falling dart impact strength.

Rubber reinforced polystyrene anisotropy was further demonstrated by measuring directional impact properties, and practical dart drop impact strength was found to correlate with the unnotched Izod impact strength on the specimens obtained perpendicular to the axis of orientation. One of the important conclusions that Dr. Keskkula pointed out was that much improved practical impact strength can be obtained if rubber reinforced polystyrene is molded at relatively high temperatures. In this way, the conventional notched Izod impact strength would lead to an opposite conclusion, since the lowest short-shot molding temperature produces the pieces with the highest impact strength.

Polymer Emulsions Unit Completed

► A polymer emulsions plant in Lemont, Ill., has been completed by the Badger Manufacturing Co., for the UBS Chemical Corp., Cambridge, Mass. This is the second emulsion unit to be placed in operation by UBS. The first was completed in 1955 at the company's Cambridge headquarters.

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SPECIAL PAPERS FOR SPECIAL PURPOSES

Names in the News

Edward P. Tagge has been appointed to the new corporate position of general auditor of Beckman Instruments, Inc., Fullerton, Calif., and **Robert A. Lineberger** was named controller of the company's Helipot and Scientific and Process Instruments Division.

Sam DuPree, vice-president in charge of production at the Goodyear Tire & Rubber Co., has been elected a director of the company.

Bill Rudko has joined the Garlock Packing Co. as superintendent, Rubber Area.

Derrill D. Copeland has been named assistant manager of retread and repair materials for the Goodyear Tire & Rubber Co., succeeding **Robert L. Martin** who has been appointed Goodyear district manager in Peoria, Ill.

Glenn H. Alvey, president of Uvalde Rock Asphalt Co., has been elected president of the Asphalt and Vinyl Asbestos Tile Institute.

A. G. Lund and **James E. Faulkner** have been elected vice-presidents of the Firestone Plantations Co., a subsidiary of Firestone Tire & Rubber Co. Mr. Faulkner was also elected president of the United States Trading Co., a Firestone subsidiary in Liberia, while **John J. Verboom** was named vice-president of the trading company.

Miles S. Pendleton, formerly general manager for the Barbour Stockwell Instrument Division of the Curtis and Marble Machine Co., has been appointed New England representative for the Hercules Filter Corp.

W. Connor Cronin has been appointed control manager of the Naugatuck, Conn., plant of the Naugatuck Chemical Division, succeeding **Eric C. Kerner** who has retired after 47 years of service with the company.

Robert U. Clemence has been named president of the Hyde Manufacturing Co., succeeding **Arthur J. LaCroix,** who has been elected chairman of the board. Other officers elected include: **F. A. Skinner,** treasurer; **H. G. Barth** and **Alan C. Ferguson,** vice-presidents; and **Russell A. Burton,** director of marketing.

Leonard R. Brice, formerly director of industrial relations for the Black-Clawson Co., has been named director of employee relations for the Dayton Rubber Co.

James W. Swaine has been appointed vice-president of the General Chemical Division of the Allied Chemical Corp. He succeeds **James G. Fox Jr.,** who was named executive vice-president of Allied's National Aniline Division.

Homer H. Bashore and **Donald R. Parker** have joined the staff of the Tonawanda, N. Y. laboratories of Linde Co.

Dr. Foster D. Snell, president of Foster D. Snell, Inc., has been given an honorary membership in the American Institute of Chemists by the New York Chapter.

William A. Angus has joined Rubber & Asbestos Corp. as vice-president, sales, a newly established executive position in the firm's marketing structure.

William L. Grey has been named to the new post of vice-president and general counsel of Anaconda Wire & Cable Co., a subsidiary of Anaconda Co., and **William H. Benton, Jr.,** has been named general manager of mills of the subsidiary.

Richard E. Drady has been appointed purchasing agent of the Heel and Sole Division of the American Biltrite Rubber Co.

Charles L. Martin, president of the Martin Co., has left that company to join the permanent sales organization of Rubbermaid, Inc.

Paul E. Cate, has been appointed director of industrial and production engineering for the Fulton Sylphon Division of Robertshaw-Fulton Controls Co.

Royal V. Mackey, Jr. has been appointed representative for the upstate New York territory for the Silicone Products Department of the General Electric Co., succeeding **Leonard J. Sacks,** who has been appointed sales representative for the eastern district.

William G. Newton, formerly chief industrial engineer for the Scientific and Process Instruments Division of Beckman Instruments, Inc., has been appointed to the newly created post of corporate industrial engineering manager.

A. T. McPherson, associate director of the U. S. Bureau of Standards and a member of the Washington Rubber Group, is ending his term as president of the Washington Academy of Science.

William L. Kurz has been elected secretary of the W. W. Sly Manufacturing Co., and he will also continue his duties as assistant to the president.

C. R. Conklin, previously eastern district manager of Republic Rubber Division, Lee Rubber & Tire Corp., has been promoted to the post of assistant general sales manager of the division.

Harold W. Francis, formerly cashier at the Goodyear State Bank, Akron, Ohio, has been appointed treasurer of the Kelly-Springfield Tire Co.

James M. McNamee has been appointed sales manager for the Petrochemicals Department of the American Cyanamid Co.

Francis X. O'Keefe, formerly associated with Wasco Chemical Co., has been appointed to the administrative staff of National Polychemicals, Inc.

Z. C. Oseland, treasurer for the Goodyear Tire & Rubber Co., has been awarded a service pin signifying 30 years of continuous association with the firm.

Joseph C. Caprino has been appointed sales engineer for the Chicago district of the Silicone Products Department of the General Electric Co. He formerly was a specialist in rubber market development for the department at Waterford, N. Y.

C. T. Schieman, Jr. has been named sales manager in the general office of Union Carbide Corp., New York, N. Y., while **T. J. Fontelieu** has been appointed to succeed him as southern region manager with headquarters in Atlanta, Ga.

John W. McGovern, president of the U. S. Rubber Co., has been elected to the board of directors of the Irving Trust Co.

Dr. Jesse Werner, formerly director of commercial development for the Dyestuff & Chemical Division, General Aniline & Film Corp., has been elected a vice-president of the corporation.

Chester M. Brown, vice-president of Allied Chemical Corp. and president of its National Aniline Division, has been elected to the board of directors of the corporation.

W. E. Greene, chairman of the board for W. E. Greene Corp., has been reappointed chairman of the Rubber Division of the New York City Cancer Committee, for its 1959 April Cancer Crusade.

John E. Bassill, president of American Enka Corp. since 1950, has resigned from that post, effective after the company's annual meeting on April 22.

Ontario Section Hears Panel On Uses of Reclaimed Rubber

► The Ontario Rubber Section held a meeting on January 13, at which 130 members heard a panel discussion on the "Uses of Reclaimed Rubber." Moderated by M. K. Parrent (General Tire of Canada), the panel was sponsored by the U. S. Rubber Reclaimers Association. Panelists were: John M. Ball (Midwest Rubber Reclaiming); P. J. Mester (Naugatuck Chemical); William R. Macy (Goodrich); John E. Brothers (Ohio Rubber); Jack E. Misner (Xylos Rubber) and G. Croft Huddleston (U. S. Rubber Reclaiming).

Mr. Ball, in his discussion on "What Is Reclaimed Rubber and How Is It Made?", stated that reclaimed rubber is the product resulting from the treatment of ground vulcanized scrap rubber tires, inner tubes and miscellaneous waste rubber articles by the application of heat and chemical agents. Through this method a substantial devulcanization or regeneration of the rubber compound to its original plastic state is effected, thus permitting compounding, processing and revulcanizing. He then went on to briefly describe five leading methods of reclaim manufacture.

Discusses Availability

Mr. Mester, who discussed "What Types of Reclaimed Rubber Are Available?" explained that it is quite difficult to spell out the specific types of reclaimed rubber available. There are so many permutations and combinations used in the production of finished reclaimed rubber that it is not easy to know which of the modifications should be classified as a distinct type and which is just a modification of existing types. He stated that, fundamentally, there are two basic factors which determine the type of reclaim, one being the type of scrap from which reclaim is made, and the other, the process by which this scrap is reclaimed.

"How Is Reclaimed Rubber Used in Tires and Other Transportation Items?" was Mr. Macy's topic. He began by mentioning figures which dealt with consumption of reclaim, natural and synthetic rubber in the U. S. and their ratio of use in tires and tire products. He then discussed several typical recipes for component tire parts.

Mr. Brothers presented "What Is the Merit of Reclaimed Rubber in Molded Goods and Other Non-Transportation Items?" He talked about the use of reclaimed rubber in relation to cost structure of the compound and some of the related cost items that reflect themselves in total cost, both directly and indirectly.

Mr. Misner's subject, "What Are Pre-Mixes and How Can They Best Be Used?" dealt with the various types of pre-mix reclaims which may be classified or identified by the type of loading and the type of reclaim such as whole tire, carcass, natural and butyl inner tube. Mr. Misner then went on to discuss several pre-mix reclaim applications.

In "What Are the Major Reasons for Using Reclaimed Rubber?", Mr. Huddleston stated that a certain amount of reclaimed rubber is essential to the manufacture of rubber products because reclaimed rubber possesses certain qualities not found in natural. He enumerated the advantages of using reclaimed rubber when compounding natural rubber, and gave several examples. A question-and-answer session was held following the presentation of each paper.

A. I. Medalia

Named By Cabot

► Dr. Avrom I. Medalia has been named head of the Fundamental Research Section for the Carbon Black Technical Department of Godfrey L. Cabot, Inc., Boston, Mass. Dr. Medalia was formerly senior research chemist of the Organic and Polymer Section of the New Products Research Department at Cabot's research and development laboratories in Cambridge, Mass. He is the co-author of the monograph, "Emulsion Polymerization"; the author of over 25 publications on polymerization and other fields; and teaches a graduate course on polymer chemistry in the Evening Division of Boston University. He received an A.B. degree from Harvard University in 1942, and in 1948, he received his Ph.D. in analytical chemistry from the University of Minnesota. He worked at the Brookhaven National Laboratory and then served as assistant director of polymer research at Boston University for three years prior to joining Cabot in 1956.

Shakespeare Named Vice-President

► Cincinnati Rubber Manufacturing Co., Cincinnati, Ohio, has announced the election of William V. Shakespeare as vice-president.

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Financial News

U.S. Rubber Profits Off 24 Per Cent in 1958

► U. S. Rubber Co., New York, N. Y., has announced that its net income for 1958 was $22,670,772, compared with $29,695,027 in 1957, a decline of 24 per cent. Common share earnings for 1958 equaled $3.05 as compared with share earnings of $4.27 for 1957. Net sales totaled $870,615,700, compared with $873,583,074 the year before. The company's business improved as 1958 advanced and final quarter sales and profits were the best for the year with earnings amounting to $1.25 a common share or 41 per cent of the firm's income for the entire 12 months. For the first time, sales of the European subsidiary, Englebert, S.A., in which U. S. Rubber now owns a majority interest, were included in the corporation's report.

In 1957, the company had extraordinary income in the form of a net profit of $3,500,000 on the sale of its wire and cable business. In 1958, extraordinary expenses were incurred in discontinuing production in two plants and transferring equipment elsewhere. According to the company, research and development expenditures continued at high levels, selling and advertising programs were not sacrificed in economy moves, and low profit commodities have been eliminated and the cost of liquidation absorbed.

U. S. Rubber's capital expenditures for new and improved property, plant and equipment totaled $27,576,000 in 1958, compared with $36,115,000 the year before. A new plastics plant was completed; a program to modernize facilities for making tires and other products was continued; a new Cuban tire plant was completed; and other overseas facilities were modernized and expanded, the company reports.

Long term debt was reduced $4,373,000 in 1958 to $164,657,000. Net working capital went up more than $13 million to $295,744,000 at the year end. Book value of common stock rose from $38.49 to $39.49 during the year.

Columbian Carbon

► Year ended December 31: Net income amounted to $3,966,000, equal to earnings of $2.46 per share of common stock, compared with 1957 income of $4,253,000, equal to $2.64 per share. Net sales for 1958 totaled $65,630,000, compared with $70,903,000 for 1957. Net income figure for 1958 includes a special credit of $394,000, or 24c a share.

Johns-Manville

► Year ended December 31: Net income amounted to $23,374,000, equal to earnings of $2.83 per share of common stock, compared with $17,782,000, equal to $2.48 per share for 1957. Net sales for 1958 totaled $331,743,000, compared with $308,293,000 for the same period of 1957. Figures in 1957 exclude sales and earnings of L.O.F. Fibers Co.

Witco Chemical

► Year ended December 31: Net income amounted to $1,911,166, equal to earnings of $2.85 per share of common stock, compared with the 1957 net income of $1,453,180, equal to $2.39 per share. Net sales for 1958 was $39,943,000 compared with $40,425,000 for the same period of 1957. The 1957 net income figure includes a special credit of $272,888, or 41c a share.

Dayton Rubber

► Year ended October 31: Net income amounted to $1,324,434, equal to earnings of $1.19 per share of common stock, compared with a net income of $1,613,634, equal to $1.59 per share in the same period of 1957. Net sales in the 1958 fiscal year totaled $85,509,634, compared with $83,613,850 in 1957.

General Tire

► Year ended December 31: Net income was $11,279,117, equal to $2.06 per share of common stock, compared with $11,300,355, equal to $2.12 per share for 1957. Net sales for the 1958 fiscal year totaled $469,782,099, compared with $421,165,147 for the same period of 1957.

American Cyanamid

► Year ended December 31: Net income amounted to $43,841,042, equal to $2.07 per share of common stock, compared with the 1957 net income of $51,347,870, equal to earnings of $2.42 a share. Net sales for 1958 totaled $525,075,577, compared with $532,479,350 for 1957.

Aetna-Standard

► Six months to December 31: Net income was $476,286, earning 94c per share of common stock, compared with $653,802, equal to $1.29 per share for the same period of 1957. Sales in the last six-months of 1958 totaled $9,010.207, compared with $17,593,692 in 1957.

Goodyear Earnings In 1958 Hit Record High

► Goodyear Tire & Rubber Co., Akron, Ohio, has announced that its earnings for 1958 were the highest in the company's 60 year history despite a 3.8 per cent sales decrease. Consolidated net income in 1958 amounted to $65,741,382, equal to $6.08 per share of common stock, compared with $64,825,516, equal to $5.99 per share for 1957. Consolidated net sales fell to $1,367,575,535 from the 1957 record volume of $1,421,850,335. Provision for United States and foreign income taxes amounted to $66,493,000 against $67,727,000 the year before.

Goodyear profits from foreign operations amounted to $18,522,652, as compared to $17,308,192 in 1957. Capital expenditures for plant expansion and improvements in 1958 totaled $53,347,979, compared with $82,947,363 in 1957. Net working capital increased to $477,100,074 at the end of 1958 from $449,191,019 at the close of 1957.

The company also announced that the board of directors proposed to increase the company's authorized common stock from 15,000,000 shares to 40,000,000 shares and change them to no par value from the current $5.00 par value. This proposal will be presented to stockholders at the annual meeting on April 6.

Plymouth Rubber

► Year ended November 29: Net income was $899,132, equal to $1.01 per share of common stock, compared with $957,591, equal to $1.07 per share for 1957. Net sales for 1958 totaled $19,651,000, compared with $19,490,000 for the previous year.

Electric Auto-Lite

► Year ended December 31: Consolidated net income amounted to $2,637,659, or $1.68 a share, compared with $7,556,944, or $4.72 a share for 1957. Net sales for the year totaled $168,904,880, compared with $267,326,870 in 1957.

St. Joseph Lead

► Year ended December 31: Net income was $3,986,880, equal to $1.47 per share of common stock, compared with $8,026,273, equal to $2.95 per share of stock for the same period of 1957. Net sales for 1958 totaled $75,615,147, compared with $106,869,864 for the same period of 1957.

A. G. Spalding

► Nine months to July 31: Net income of $690,000, which is equal to $1.07 per share, compared with $735,000, or $1.14, during the same period of the preceding year.

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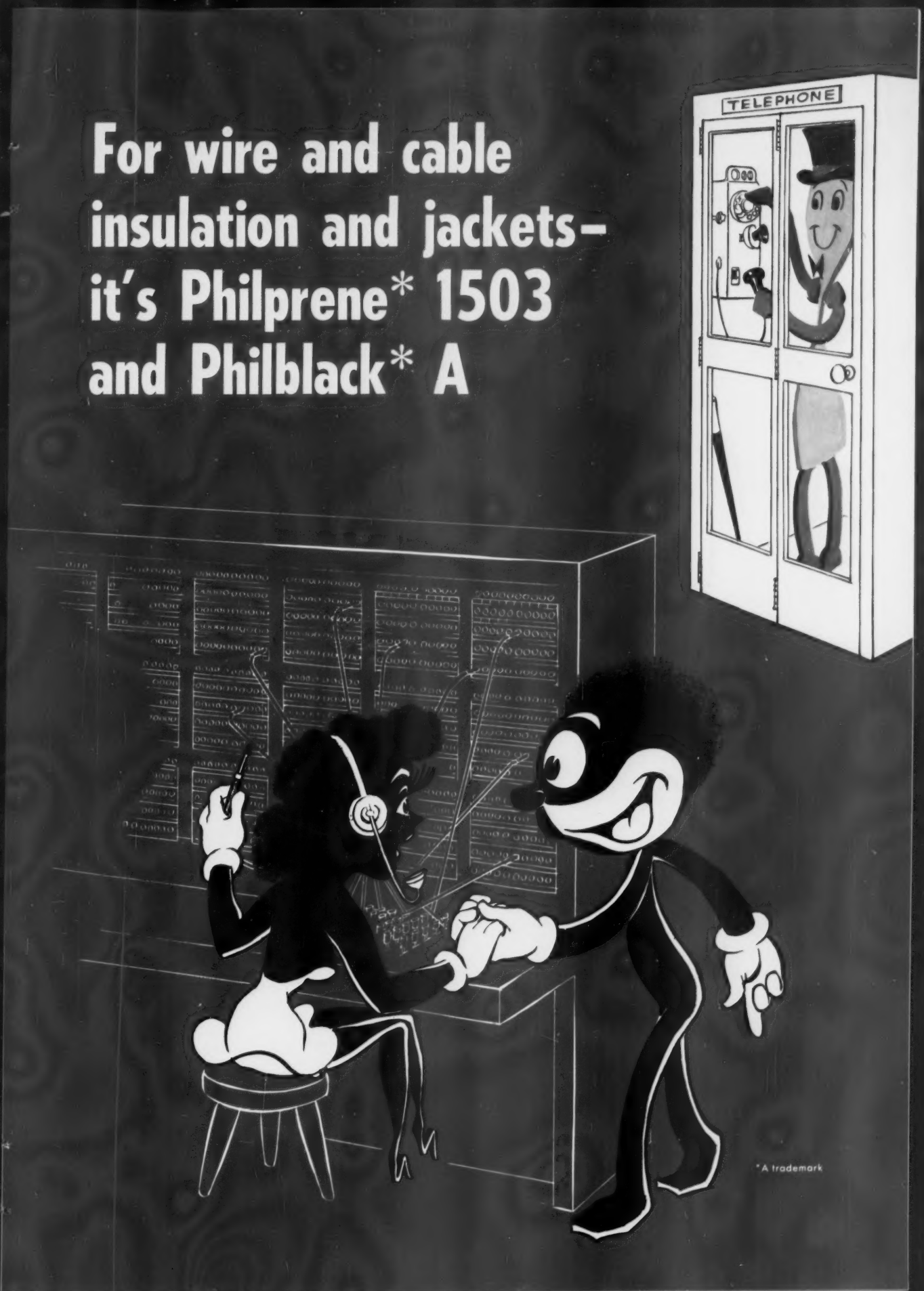

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COLD	PHILPRENE 1500 PHILPRENE 1502 PHILPRENE 1503	PHILPRENE 1601 PHILPRENE 1605 PHILPRENE 6611** **(Pigmented with EPC Black)
COLD OIL	PHILPRENE 1708 PHILPRENE 1712	PHILPRENE 1803 PHILPRENE 6605 PHILPRENE 1805 PHILPRENE 6608 PHILPRENE 6604 PHILPRENE 6620

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Export Sales: 80 Broadway, New York 5, N. Y. *European Office:* Limmatquai 70, Zurich 1, Switzerland

West Coast: Harwick Standard Chemical Company, Los Angeles, California

Cabot Organizational Changes

► Godfrey L. Cabot, Inc., Boston, Mass., has announced organizational changes in the Sales Department of its Minerals and Chemicals Division including the appointment of Henry P. Donohue, Jr., as eastern sales manager of non-ceramic industries and Frank E. Daley as eastern ceramic sales manager. Warren M. Parsons has been named western sales manager of non-ceramics while Frank J. Zvant has been appointed western ceramic sales manager. Mr. Donohue, after receiving his B.S. degree in chemical engineering at Tufts University, spent two years in the U. S. Navy and then joined Cabot's Research and Development Laboratories as a chemical engineer. He worked in applied and market research and in 1955, transferred to the Minerals & Chemicals Division as product manager for "Cab-O-Sil."

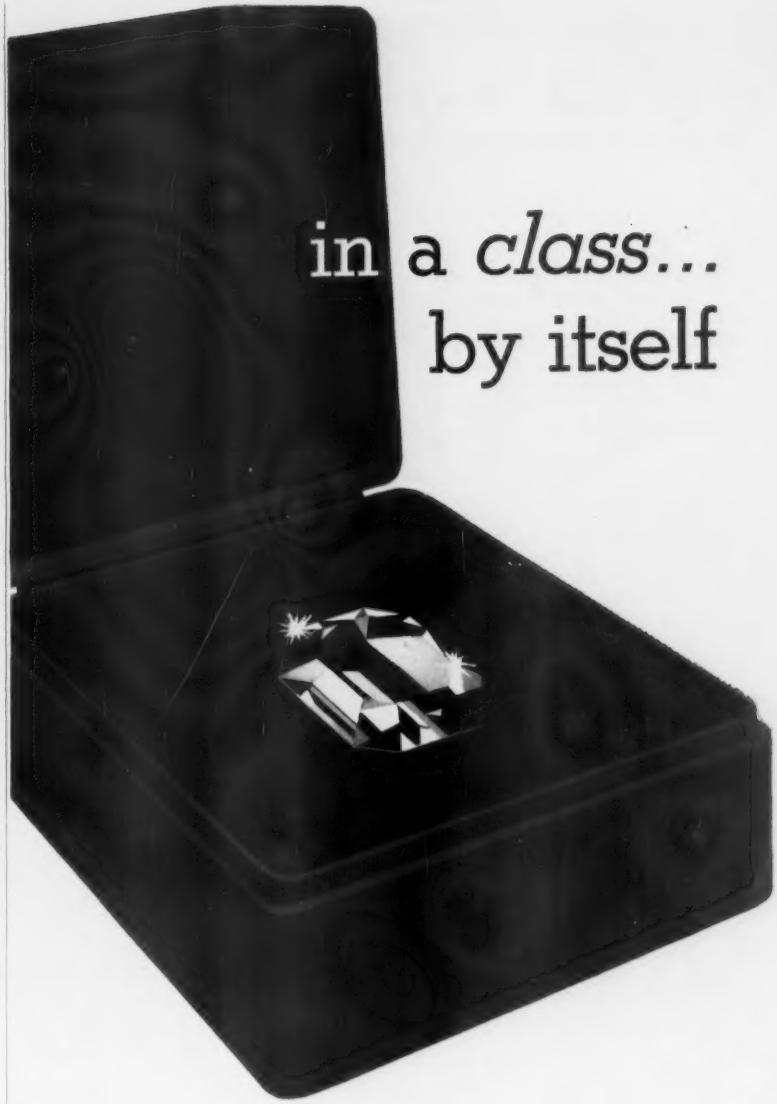
Mr. Daley has been with the Sales Department of the division since 1952. After graduating from Rutgers University, with a B.S. degree in ceramics, he spent five years as a ceramics engineer with American Radiator & Standard Sanitary Co. before joining Cabot. Mr. Parsons served as a chemist in the chemical and paint industry before joining Cabot in its Research and Development Laboratories in Cambridge, Mass. Later, he transferred to the Minerals & Chemicals Division as a salesman. A graduate of Tufts University, he holds a B.S. degree in chemistry. Mr. Zvant has a Ph.D. in chemistry from the University of Missouri, an M.S. degree in ceramic engineering from the University of Washington and a B.S. degree in ceramic engineering from the Missouri School of Mines. He joined Cabot in 1952 and has worked with the ceramic industry in the development and sales of Cabot's white pigments.

RFMA Announces Name Change

► At the annual general meeting of the Rubber Footwear Manufacturers' Association, held in London, England, recently it was decided to change the Association's name to "Rubber and Plastics Footwear Manufacturers' Association," in view of the wider range of materials now used by most manufacturers. During the meeting, officers were elected for 1959-1960, including *Chairman*, A. D. McDiarmid (North British Rubber); *Deputy Chairman*, H. H. Townsend (Greengate & Irwell Rubber); *Honorary Secretary*, A. W. Oxer (Dunlop Footwear); *Honorary Auditor*, J. S. Grimshaw (B. T. R. Industries).

Named Representative

► Chemicals and Pigments Corp., Newton, Mass., has announced its appointment as exclusive representative by the National Chemical and Plastics Corp., Baltimore, Md. The company will handle National's complete line of finishes in the New York area.



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West Coast News

► The Los Angeles Rubber Group, Inc., has announced that its spring semester, consisting of three rubber technology courses has been underway since February 5. Rubber Technology I is a lecture course on natural and synthetic rubbers; their production; testing; compounding; processing and uses; and developments in the rubber industry. Rubber Technology II is a seminar type of course with background lectures and reports by students on recent rubber literature.

Basic Rubber Technology is a practical course for technical and non-technical students dealing with natural and synthetic rubber; basic compounding; processing; curing; mold design; cements; and factory engineering. Course I is worth two unit credits and Course II, three unit credits. The course on Basic Rubber technology is non-credit.

Tlargi Rubber Technology Foundation at the University of Southern California has announced that a $3500 fellowship is available for full time research work in the field of rubber or elastomers for one year toward an M. S. in chemical engineering. To qualify, an applicant should have a B.S. in chemical engineering and some courses in the field of elastomers or equivalent experience. Applications should include courses taken and grades received. Further information may be obtained from Dr. E. G. Partridge, director, Tlargi Rubber Technology Foundation, School of Engineering, University of Southern California, Los Angeles 7, Calif.

Prize winners at the Tlargi February 3 monthly meeting included: *Door Prize*, Bill Scheuermann (Plastic & Rubber); *Bar Drawing*, F. D. Stockwell (Firestone); *Raffle Drawings*, Don P. O'Connell (Shell Chemical); Ken W. Drury (Federal - Mogul - Bower Bearing); Joe G. Jones (Lamb Rubber); Walt F. Kearney and Bill Schwager (Firestone); Leonard C. Boller (Coast Pro-Seal) and Tony T. Lipsky (Fullerton).

► Burke Rubber Co. has announced plans to add a new wing to the main manufacturing plant at San Jose, Calif., which the company moved into a year and a half ago. Halsey Burke, executive vice-president of the firm, said that increased volume of sales made it necessary to add the new wing in order to provide continued economical production facilities. One of the features of the new addition will be a completely separated and closed off area for mixing and storing black stocks. One Banbury will be in the black mixing area and the other in the colored mixing area.

Designed by Norman Burke, vice-president, the new addition is a tilt-up concrete construction, which will add 14,000 square feet to the plant's present 54,000 square foot area. The company has broadened sales outlets into many new product lines under the supervision of Virgil Price, manager of the Industrial Rubber Goods Division. Staff and facilities have also been broadened under the direction of Drace Kutnewsky, technical director, in order to handle the increased volume of precision molding and specification work.

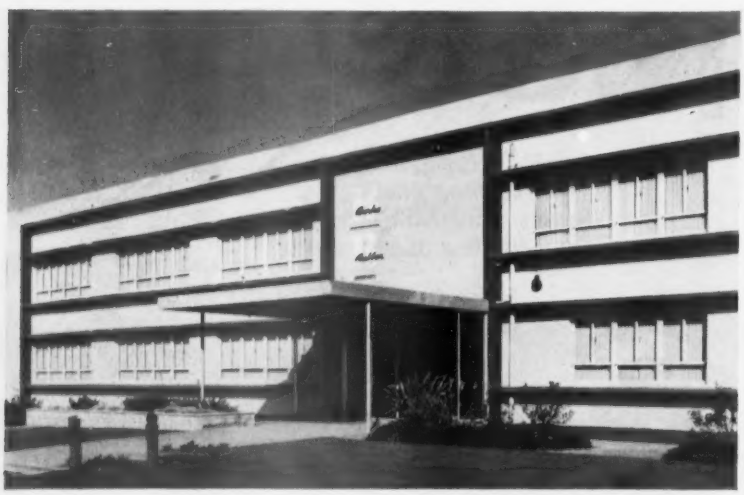
► In an address to members of the Pasadena Advertising Club, L. T. Greiner, Pacific regional manager for the B. F. Goodrich Tire Co., said "advertisers generally should rely on research and not their own judgment to determine what the public wants." His company's advertising program, he explained, which uses the word "smileage" to associate car driving with pleasure, was evolved after hundreds of interviews with motorists. It was found that car owners want to enjoy driving and do not like to be reminded of irritations such as operating costs, upkeep and traffic jams.

Mr. Greiner told the group that businessmen who want to insure future success must set long range plans that take into account changes in population, changes in people's living and working habits and changes in the nation's technological growth. He suggested that businessmen make their plans for the future on five, six or even ten year bases to see which way their business might be destined to go.

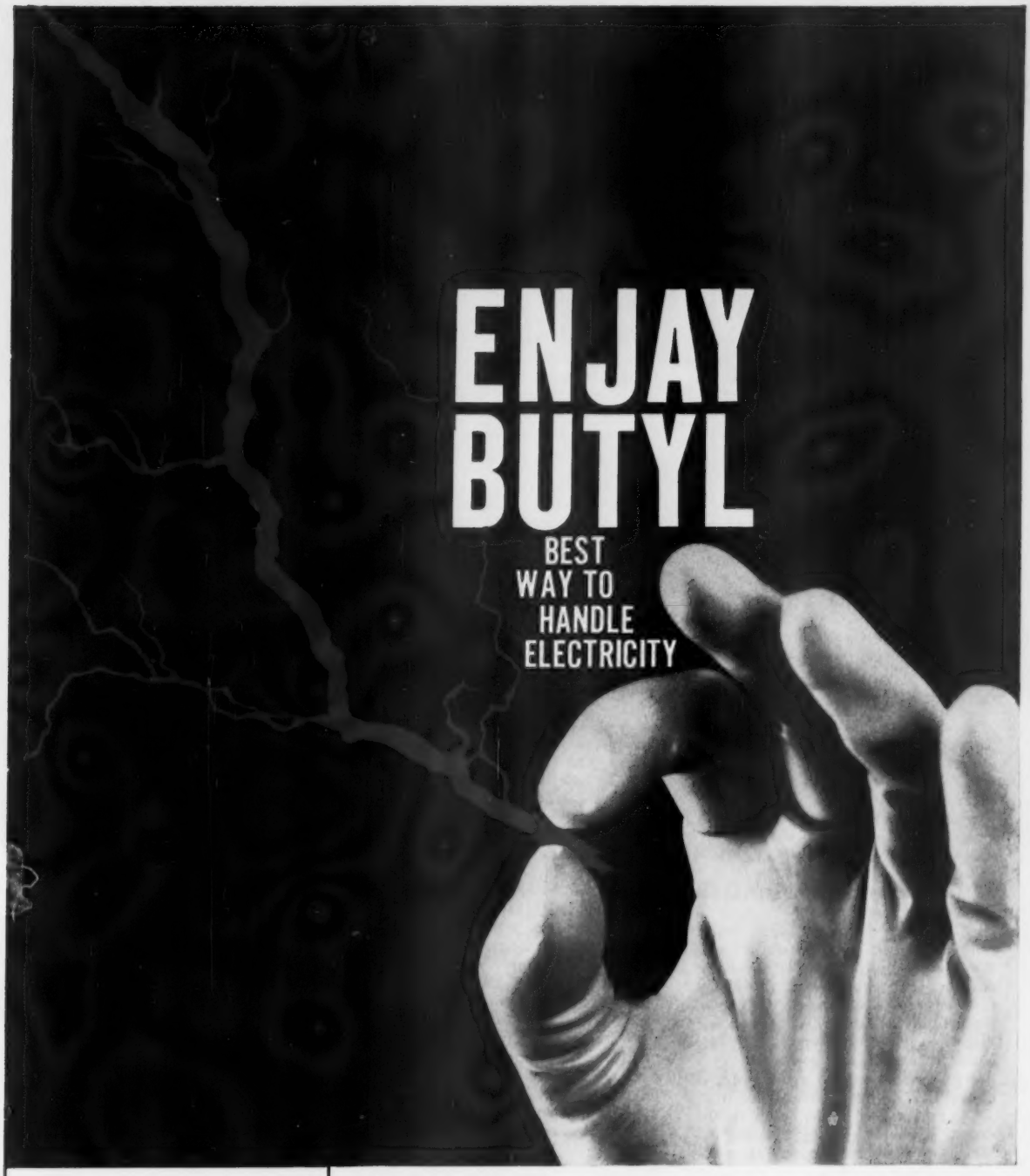
N. R. Legge, head of the Synthetic Rubber Department for Shell Development Co.

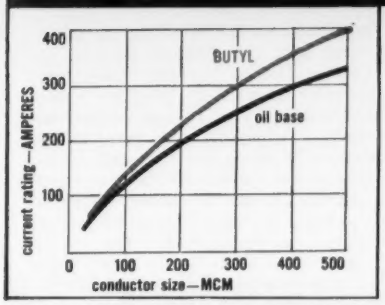
► Aerojet-General Corp., a subsidiary of the General Tire and Rubber Co., has announced that Dr. A. L. Antonio, who directed Aerojet-General's solid propellant research and development from 1944 to 1954, has returned as vice-president of the Chemical Division. For the past four years, Dr. Antonio has been general manager for the Chemical Division of the parent company. The company has also announced that Dr. George Moe has been appointed head of the Aerojet Astronautics Laboratory, which is currently engaged in research on advance propulsion systems and other specialized programs. Wilbur G. Clayton has been designated logistics coordinator for the Titan weapons system program for the Turbo-Machinery Division.

► Shell Development Co., Emeryville, Calif., has announced the creation of two new research departments, the Synthetic Rubber Department and the Thermoplastics Department. The new departments result from a division of the Polymer and Chemical Applications Department. Dr. N. R. Legge has been appointed head of the Synthetic Rubber Department while Dr. F. E. Condo has been named acting head of the Thermoplastics Department.



Plant of the Burke Rubber Co., San Jose, Calif., to which a new wing has been added.





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Canadian News

► B. F. Goodrich Canada Ltd., Kitchener, Ontario, a wholly-owned subsidiary of B. F. Goodrich Co., Akron, Ohio, has issued a denial of a charge made in the Canadian House of Commons in Ottawa, that it had refused to do business with Red China. Robert V. Yohe, president of Goodrich Canada, stated, "On investigation we find that our company definitely was never asked to sell to Red China because we do not manufacture the type of belting sought by them." He added, "If we receive a direct request to tender on conveyor belts from Red China, it will receive every consideration . . . the same as any order originating in Canada."

Mr. Yohe explained that the Canadian firm had no sales organization to cope with export contracts and admitted that it has never sold a dollar's worth of goods overseas. An earlier statement by W. B. Flora, Goodrich Canada's vice-president for sales, revealed that the company's International Division in the U.S. handled all exports and the Canadian subsidiary doesn't even quote on them.

In Akron, G. W. Hill, the parent company's sales manager, said that it was "logical" that the Canadian company would conduct its own business in any deal with Red China. However, Mr. Hill agreed that there would have to be "consultation" with the U.S. company officials "about the ramifications" of such a move.

On the floor of Commons, Harold Winch, CCF member for Vancouver-East, charged that the United States company vetoed any deal when Canadian Goodrich proposed that advantage be taken of a reported need for belting at Chungking. According to Mr. Winch, the refusal to discuss the belting sale originated with the parent company, which issued the statement that "under the present regulation of our government (U.S.) we are prohibited from dealing with Red China, even to the extent of communicating with the nationals of Red China in any manner."

Mr. Winch called on the Canadian government to "make it clear to the United States that we, in this country, are not going to brook any continuation of this kind of interference. If this sort of thing does continue, it is up to this government to introduce legislation that will enable us to control the exports of our own corporations," he said.

Mr. Yohe reported that in a recent public speech he advocated a national campaign to "sell Canadian" which would be followed by "buy Canadian." "I had in mind," said Mr. Yohe, "the objective of selling Canadian goods to domestic as well as expert markets. Any foreign purchasers would receive exactly the same consideration as Canadian purchasers coming to B. F. Goodrich Canada Ltd. This would be 'selling Canadian' and providing Canadian employment and business."

► Firestone Tire and Rubber Co. of Canada Ltd., Hamilton, Ont., has announced the appointment of Robert Taylor, formerly production manager, to the post of factory manager. Alfred Horrax, who was previously chief engineer, will succeed Mr. Taylor as production manager at the Hamilton plant, while C. R. Strand, staff engineer at Plant 2, Akron, Ohio, has been named chief engineer succeeding Mr. Horrax. The promotions have been made in view of the retirement of J. H. Forman, effective May 1, as vice-president in charge of production.

With Firestone 35 years, Mr. Taylor has been production manager since 1945. He joined Firestone at the Hamilton plant in the Mechanical Department in 1923 and was named chief engineer in 1936. During World War II, he was transferred to Akron where he held supervisory positions in the Gun Mount and Air Wings Division, returning to Canada in 1944. Born in Scotland, Mr. Taylor graduated from Hamilton Technical Institute in 1919.

Mr. Horrax was born in England and is a 1941 graduate of the University of Manchester with a B.S. degree in electrical engineering. He joined Firestone's 1946 college training class in Akron and has held electrical engineering positions at both the Pottstown, Penna., and Hamilton plants. He was named chief engineer at the Hamilton plant in 1951. Mr. Horrax is a member of the Association of Professional Engineers of Ontario.

Mr. Strand received a B.S. degree in electrical engineering from Michigan State University in 1948, and then joined Firestone's college training class in Akron, holding several staff engineering positions there.

► Polymer Corp., Ltd., Sarnia, Ont., has announced a 1959 capital budget expenditure of $6.6 million with $4.2 million slated for capital items related to improvement of plant efficiency and product quality; extension of employee facilities; and the continuation of a program of waste disposal system. The 1959 budget also provides for the beginning of a butadiene plant in Western Canada. Due to delays in the assured build-up of substantial gas exports from Alberta, the company has not yet completed the butane agreements necessary to supply the proposed plant in Alberta. According to Polymer, the use of field butanes processed in Alberta continues to be the best means of filling its butadiene requirements.

The remaining $2.4 million has been allocated to projects already underway and will provide for winter employment for about 150 construction workers in Sarnia. A new pilot plant for work on new polymers based on stereospecific catalysts and new warehouse facilities have been included in this section of the budget.

► B. F. Goodrich Co. has announced the appointment of M. F. Fitzgerald, vice-president and general manager of B. F. Goodrich Sponge Products Canada, Ltd., to the post of managing director of B. F. Goodrich do Brazil, Campanas, Brazil. The company also has announced the appointment of Earl D. Gunn to succeed Mr. Fitzgerald in Canada. Mr. Gunn, manager of manufacturing of sponge and plastics products at the Sponge Products Division, Shelton, Conn., has also been elected a director and named vice-president of the Canadian company.

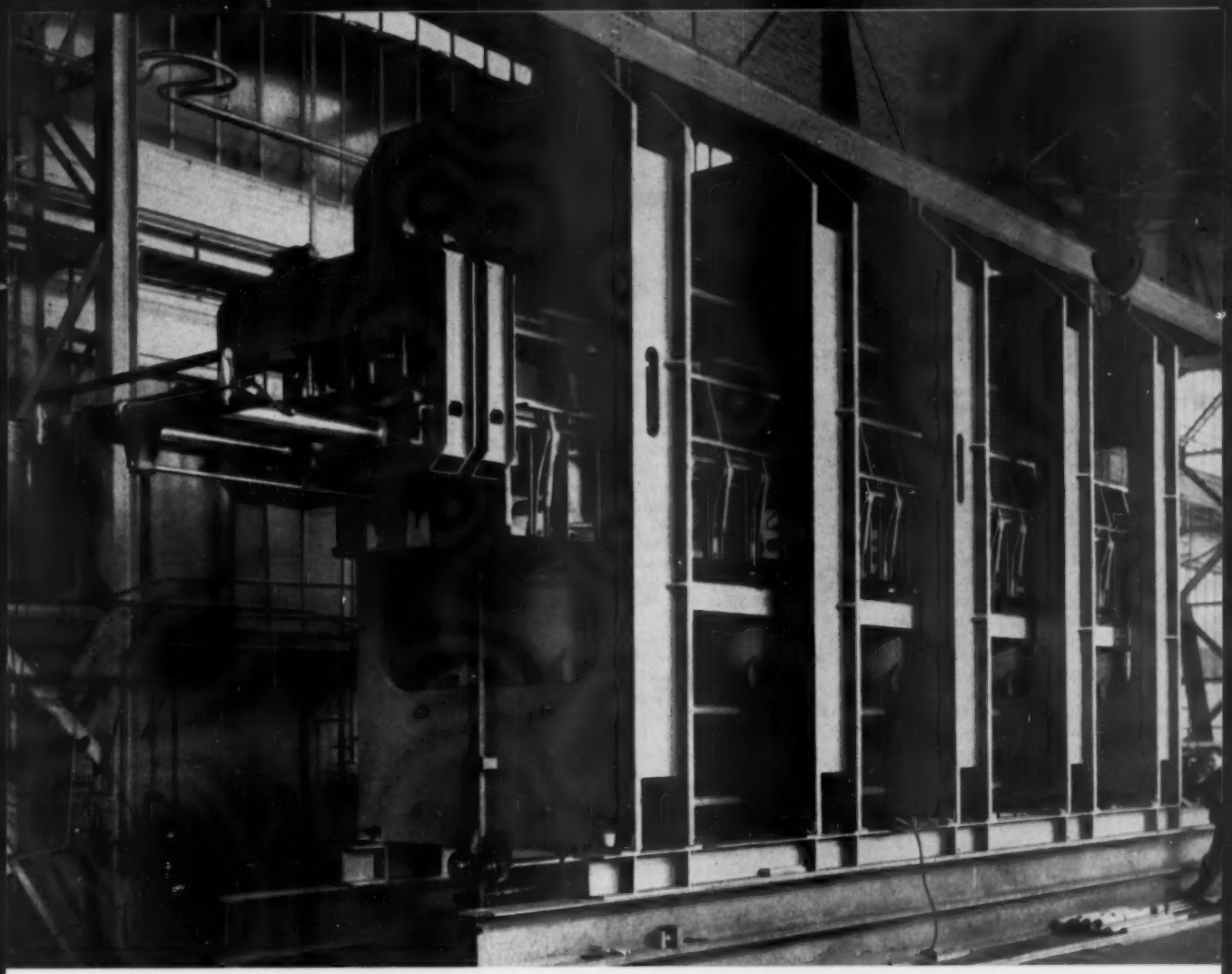
► Dominion Rubber Co., Ltd., Montreal, a subsidiary of the U. S. Rubber Co., has announced the appointment of Merrill F. Anderson as executive vice-president. Mr. Anderson was formerly general manager of the Naugatuck Chemical, Latex and Reclaim Divisions of Dominion. He will make his headquarters in the company's executive offices in Montreal.

► Kelly-Springfield Tire Co., Cumberland, Md., has begun operations in Canada under the name of Kelly-Springfield Tire Co., of Canada, Ltd., with manufacturing facilities in Ontario. Fred Thornton is heading the Canadian company as vice-president and managing director.

► Northern Electric Co., Ltd., Lachine, Quebec, Canada, has announced the promotion of L. G. Little to general manager of its Wire & Cable Division. Mr. Little, formerly assistant general manager of the division, is a member of the Armored Cable Section and the Wire and Cable Section of NEMA.

Wayne Conducts Rubber Courses

► Wayne State University, in cooperation with the Detroit Rubber and Plastics Group, has begun its spring semester courses in practical rubber technology. Two courses in practical rubber technology are being given, Course II being an advanced lecture course and Course III, the laboratory course. Course II sessions began on February 13, while Course III sessions started on February 9. The courses consist of a study of the fundamental properties of natural and synthetic rubbers, emphasizing their effects upon compounding, processing and application of these rubbers.



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Obituaries

Clinton H. Crane

► Clinton Hoadley Crane, former president and retired chairman of the St. Joseph Lead Co., New York, N. Y., died on November 1 in Rockport, Maine. He was 85 years old. Mr. Crane was born in Englewood, N. J., and after receiving a degree from Harvard in 1894, he spent three years studying engineering and naval architecture at the University of Glasgow. For the next two years, he worked in the shipyards of William Cramp & Sons in Philadelphia, Penna. He joined the firm of Tams, Lemoine & Crane, yacht designers, in 1900. He and his brother, Henry M. Crane, designed the Dixie I, a high-speed motorboat that brought the Harmsworth Cup to the United States.

Mr. Crane ended his professional practice of naval architecture in 1913, when he became president of the St. Joseph Lead Co. He resigned as president of the organization in 1947, became chairman of the board, and retired from that post in 1957, although he continued as a trustee of the company. During World War I, Mr. Crane served under Bernard Baruch on the War Industries Board. He became president of the Lead Industries Association at its formation and served until 1947. Mr. Crane was the recipient of many honors and a member of several technical and social organizations. He is survived by his wife and a daughter.

Carl L. Wiland

► Carl L. Wiland, a veteran of 38 years service with Goodyear Tire & Rubber Co., Akron, Ohio, died on February 9 while at work in the Development Department of Goodyear in Akron. He was 58 years old. Mr. Wiland was active in the Masonic Fraternity. He was also a member of the Adoniram Lodge 517, F&AM; Akron Chapter 209, Royal Arch Masons; Akron Council 80, Royal and Select Masters; and the Knights Templar. He belonged to the Goodyear Foremen's Club and Goodyear Twenty-Five Year Club, of which he formerly was a trustee. Surviving are his wife, a son and a daughter.

Albert G. Freudeman

► Albert G. Freudeman, retired purchasing agent of the B. F. Goodrich Co., died on December 20 in City Hospital, Akron, Ohio. He was 73 years old. He retired from Goodrich in 1953 and had been active in Masonic circles as a member of the Adoniram Lodge 517. He is survived by his wife and five daughters.

James G. Park

► James Grant Park, retired vice-president and director of Enjay Co., Inc., a subsidiary of Standard Oil Co. (N.J.), died on January 29 at his home in New York City. He was 62 years old. Mr. Park was born in Brooklyn, N.Y. and received a B.S. degree from Brooklyn Polytechnic Institute in 1919, and an M.S. degree in 1928 from the same institution. He joined Standard Oil as a member of its foreign staff in 1920, and served in Brazil until 1924. He then served as sales representative, division head, division sales manager and sales manager of alcohol sales with the parent company and its subsidiary.

In 1938, Mr. Park was named a vice-president of the division, which was known as the petrochemical marketing subsidiary. He retired in July, 1958. Mr. Park has been honored by the Chemical Market Research Association, of which he was the organizing president. He was past president of the Salesmen's Association of the American Chemical Industry and a member of the American Institute of Chemists, the Society of Chemical Industries (American Section), the Commercial Chemical Development Association and the American Chemical Society. Surviving are his wife and a daughter.

George H. Wallace

► George H. Wallace, retired manager of the analytical laboratory of Firestone Tire & Rubber Co., Akron, Ohio, died on December 22 at the home of his sister in Port Jefferson, L. I., N. Y. He was 64 years old. Mr. Wallace retired from Firestone on December 1, 1957 after 32 years of service with the company. He joined Firestone as a compounder and was head of the analytical laboratory from 1948. He received his B.A. and M.A. degrees from Union College and his Ph.D. degree from Columbia University in 1925. Mr. Wallace was a member of Akron Lodge 83, F&AM.

W. R. Veazey

► Dr. W. R. Veazey, a retired chemical engineer and former head of the Chemical Engineering Department at the Case Institute of Technology, died on December 4. He had been hospitalized since July with a heart ailment. Dr. Veazey was a director of the Dow Chemical Co. for more than 30 years and once headed the company's Research Laboratories. A $3 million Dow Research Laboratory in Freeport, Texas, is named after him.

Carl J. Minnig

► Carl J. Minnig, consultant for the Witco Chemical Co., Inc., New York, N. Y., died on February 15 at his home in Riviera Beach, Fla. He was 69 years old. Mr. Minnig, who was born in Erie, Penna., had been associated with the rubber industry for more than 20 years. He began his career in 1922, when he joined the Phillips Petroleum Co. Later he was named manager of the Gas Department, serving in that capacity until 1936. During his career with Phillips, Mr. Minnig was instrumental in the development of new gas fields in the Texas Panhandle area as a source of natural gas for the production of carbon black. He also helped to promote the use of gas in industry.

In 1936, Mr. Minnig joined Continental Carbon Co. as a vice-president for carbon black sales. During the war years, when Witco Chemical took over the sales of carbon black for Continental Carbon, Mr. Minning was named vice-president of carbon black sales for Witco. He retired from this post in October, 1954, but continued to serve the company as a consultant until his death. Mr. Minnig was a member of the Rubber Division of the American Chemical Society and of the American Gas Association. He is survived by his wife and two sons, one of whom, Max Minnig, is president of Witco Chemical.

Donald G. Rogers

► Donald G. Rogers, who retired in 1957 as president of the National Aniline Division of the Allied Chemical Corp., died on December 30 at Valley Hospital, Ridgewood, N. J. after an illness of three months. He was 66 years old. Mr. Rogers was graduated from Worcester Polytechnic Institute with a B.S. degree in chemistry and he belonged to the American Chemical Society, the American Association for the Advancement of Science, the Chemists Club of New York and the Downtown Athletic Club. He is survived by his wife and three sons.

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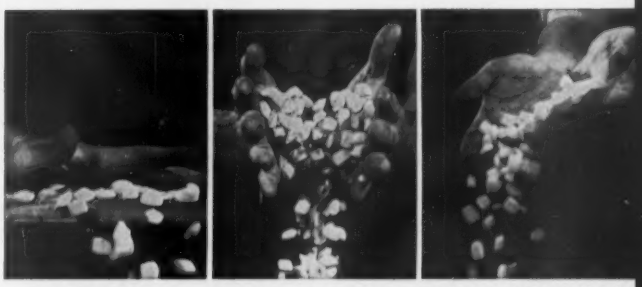

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*Textile Machinery will not be shown at 1959 Fair

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New Goods

Goodrich Maxecon Heel

► Shoe Products Division of the B. F. Goodrich Industrial Products Co., Akron, Ohio, has developed a new crepe heel which is an integral part of the sole. According to the company, the heel doesn't need nails, glue or other adhesive, yet can't work loose from a shoe. There's no chance of heel-sole separation because there is nothing to separate. The new soling material,

known as "Maxecon", is designed primarily for men's dress shoes. This design, said to be the first construction of its kind, is molded from the same crepe rubber material at the same time in a continuous one-piece construction with the sole.

The new construction eliminates the problem of color-matching and heels and soles are positioned with precision attainable only through the molding process. Goodrich states that Maxecon crepe soles are made of high grade synthetic rubbers that have exceptional resistance to abrasion and scuffing, are waterproof and identified with a molded branding that will not come loose or wear out.

G. S. Bottle Carrier

► General Scientific Equipment Co., 7516 Limekiln Pike, Philadelphia, Penna., has announced the development of a new safety bottle carrier for safe, practical handling of chemicals in glass containers. A thick-walled polyethylene container, the "G. S. Bottle Carrier" has safety features designed into it, according to the company. For ease in handling, the carrier has a heavy wire handle sealed in plastisol and secured to integrally molded on ears. The bottle is held firmly in place with a snap cover, which helps to cushion it from shocks and prevent breakage. In tests, this container has withstood hard use for over a year without breakage of a single bottle, the company states.

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This machine Die Cuts closed and open cell sponge, urethanes, cork rubber gaskets, foam rubber, Sissal, uncured stocks, etc. With a multiple cavity die assembly you can pre-determine scrap loss on any job and figure it into your costs. The combination of vertical and horizontal die handling equipment on this machine has reduced the cutting cycle to 10 seconds — six complete cutting impressions per minute!

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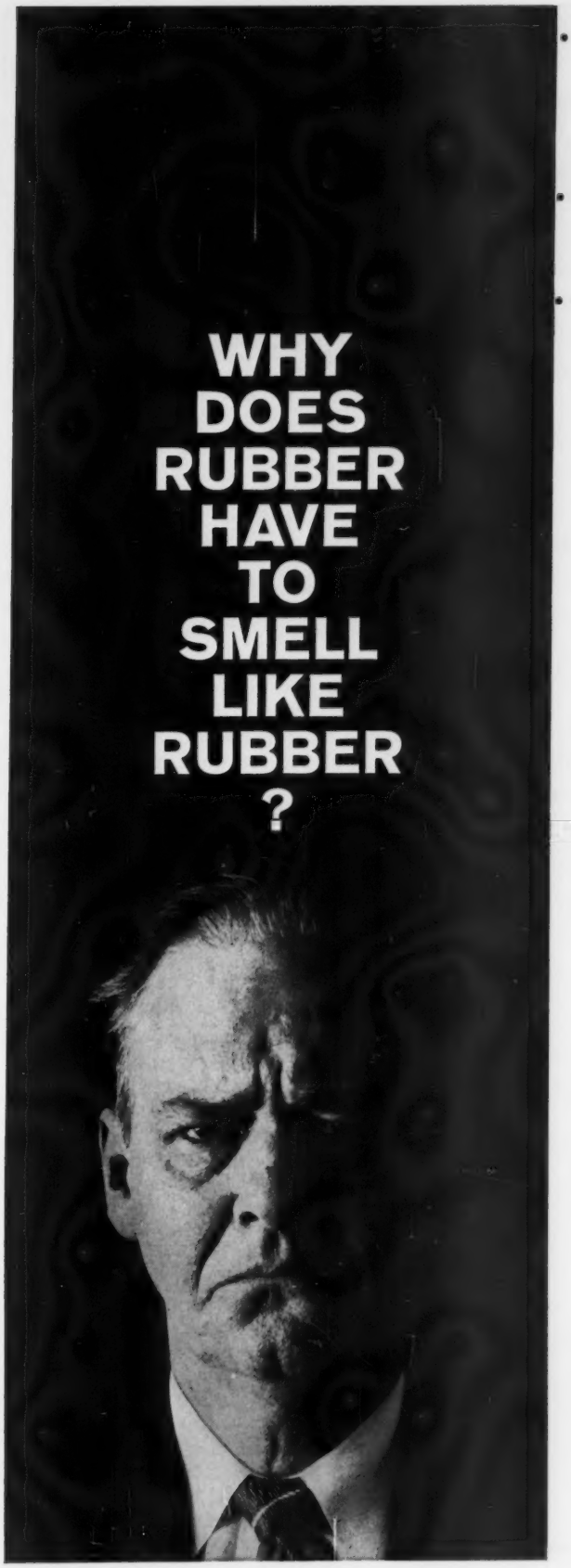

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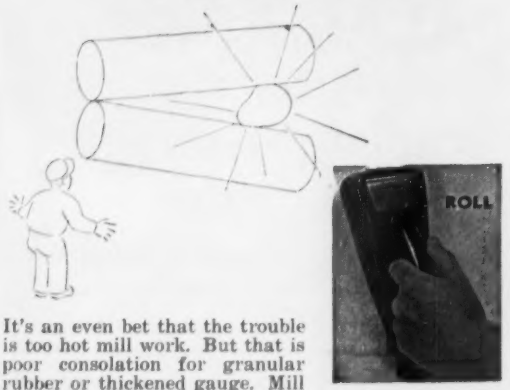
When Lumps show up in the Calender Rolls



It's an even bet that the trouble is too hot mill work. But that is poor consolation for granular rubber or thickened gauge. Mill roll temperature can be easily checked, therefore intelligently controlled by the use of the Cambridge Surface Pyrometer. It is an accurate, rugged instrument that can be used while the rolls are in operation. Its use will help cut costs and make better rubber products. *Send for Bulletin.*

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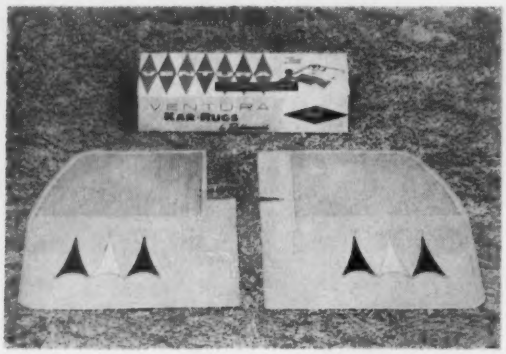
Ventura Kar-Rug

► Rubbermaid, Inc., Wooster, Ohio, has introduced the "Ventura Kar-Rug", which features color-inserts in a new design for all makes of automobiles. Styling of the Ventura follows the advanced concept of motion-in-design of 1959 models, the company states. A new rubber compound just developed by the company will be



used for the first time in the new Ventura series. This compound is said to give excellent flexibility which will permit the new Kar-Rug to conform more closely to contoured floors. A twin-contour Kar-Rug is available for both front and rear floors. The front floor set is shaped for taper and slope on either side of the hump, with the left side inset for the accelerator. The matching rear Ventura is rectangular and has universal application. Each rug has delta-wing inserts in colors that complement and contrast with the base color of the Kar-Rug.

Synthetic Chamois

► A cleaning and drying cloth, called "Chamie-Tex", has been imported from West Germany for distribution by Milwaukee Dustless Brush Co., Milwaukee, Wisc. The company reports that the cloth, made of nitrile rubber and nylon, can be used wherever natural chamois would be used, and in many jobs where chamois is useless. According to the company, Chamie-Tex cannot be harmed by grease, oil or solvent and can be cleaned by rinsing in any solvent or laundered in any soap or detergent, which would ruin ordinary chamois. In fact, the company states, Chamie-Tex improves with each laundering, becoming better with use. Chamie-Tex is reported to leave a smooth, dry surface, absorbing liquid as it works, and it never becomes slippery or slimy. Wet or dry, it stays soft, will not rot or mildew and can be stored damp and allowed to dry naturally, the company states. Chamie-Tex measures 18 by 21 inches and is available through both housewares and department stores and industrial supply distributors.

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Skope Safety Suit

► Skope Manufacturing Corp., Norwood, Mass., has introduced a kit containing the necessary materials for a new type of skin diving suit, which comes in a variety of colors. The suit is said to be safer than black gear now in use because of its greater visibility under water. Called the "Skope Safety Suit", it is made of Ensolite, a

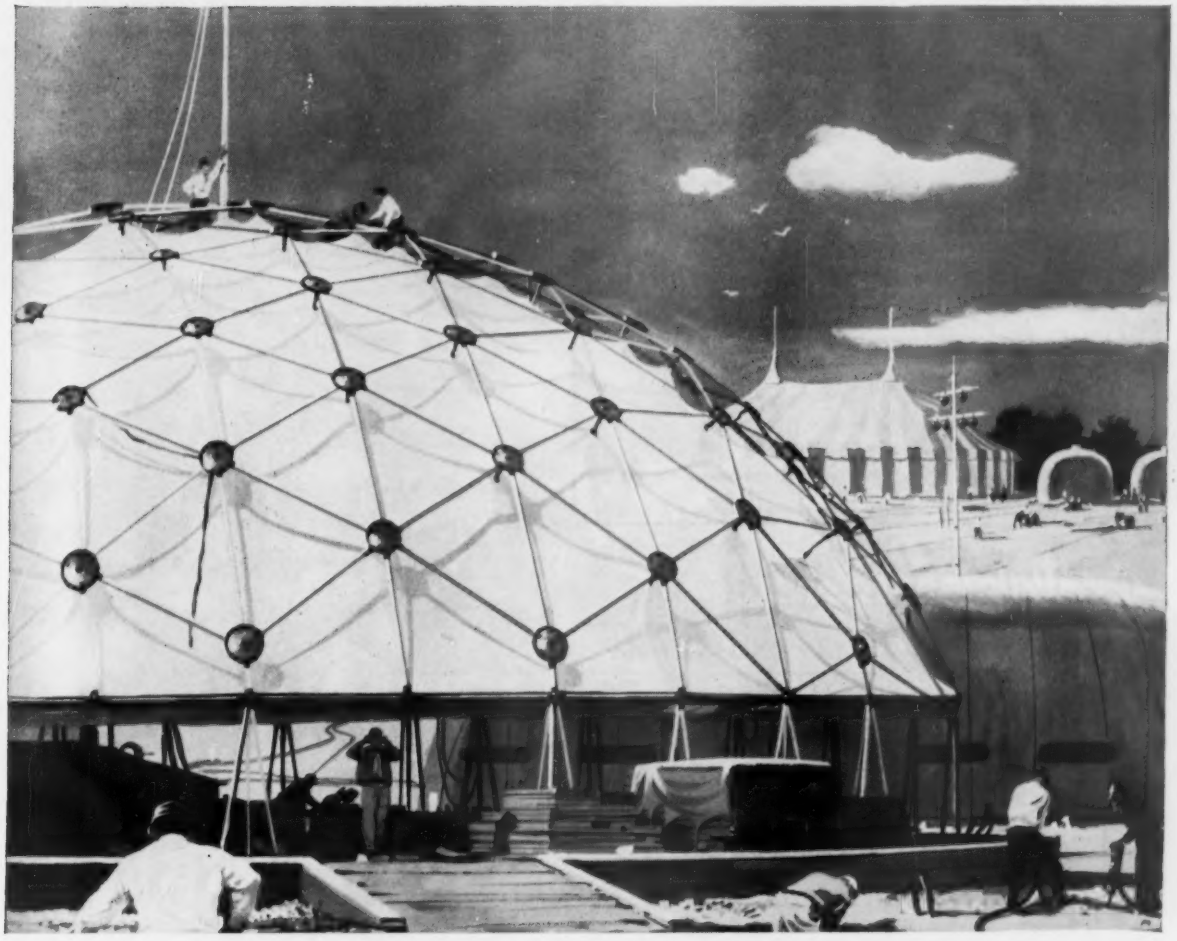
closed-cell vinyl sponge developed by the U. S. Rubber Co. The suit is warmer than conventional skin diver's gear and is more buoyant, and therefore safer, the company states. If the oxygen supply fails, the diver releases his weight belt and the material itself brings him safely to the surface. A further advantage is that the user does not have to powder the inside surface before putting the suit on. It slips on easily after it has been dipped in water. The kit includes the Ensolite material, patterns, glue, color touch up and instructions to make the hood, jacket, pants and sox. Three sizes will be marketed in white, green, blue and red.

One-Piece Urethane Arm Rests

► Davidson Rubber Co., 50 Brighton St., Charlestown, Mass., has developed new one-piece arm rests containing urethane foam. The company believes the new arm rests will, in many cases, be easier for automobile manufacturers to install than the multi-piece arm rests. Because they are molded in one piece, into a polyvinyl chloride shell, the arm rests are said to have better wearing qualities and may be designed in almost any size or shape. The softness and cushioning property of the foam also contributes to the safety and comfort of automobile passengers.

• *"Geodesic"* structure is made of vinyl coated "Welkote," Wellington Sears nylon fabric engineered for vinyl and neoprene coating. Fabric is suspended from its rigid framework —no interior posts or supports.*

*Pat'd by R. Buckminster Fuller



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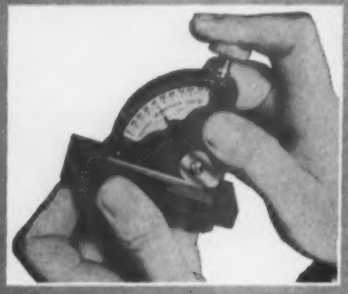

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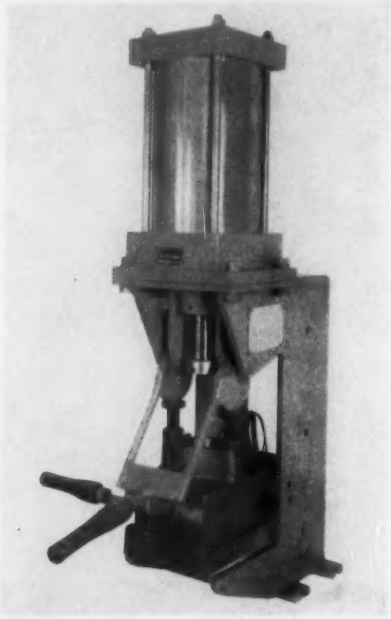
► Sivon Manufacturing Co., Painesville, Ohio, has developed a press designed to circumvent difficulties often encountered in splicing irregular forms or molded parts to extruded material. In this unit, designated No. 600 Smaco, the molding and splicing process is accomplished at the same



time, eliminating the press job of forming the parts to be spliced to the extruded elements. The extra work involved in removing flash prior to splicing is also eliminated. The molding of rubber insulation around electric terminals, cords, and plugs can be done by the press. Electric cartridge units for 110 or 220 volts supply the heat, which is controlled by thermoswitches of a variant ±3°F. of heat from room temperature to 400°F. The ram and well bushings have hardened and chromed surfaces. Mold sizes are 2 x 3-inches thick by 5¾ x 6 inches. The press requires floor or bench space of 10 x 12 inches, and stands 33 inches high. Adjustable cam action constitutes the hold down pressure, while a powerful air cylinder furnishes the injection medium at controlled speeds. The manually operated hold down mechanism eliminates an extra cylinder for this purpose. A self-centering ram contains a specially designed form for automatic extraction of scrap stock usually left in the well. The well capacity is 9 cubic inches. Optional equipment includes water separator and oiler, automatic timer and air controls.

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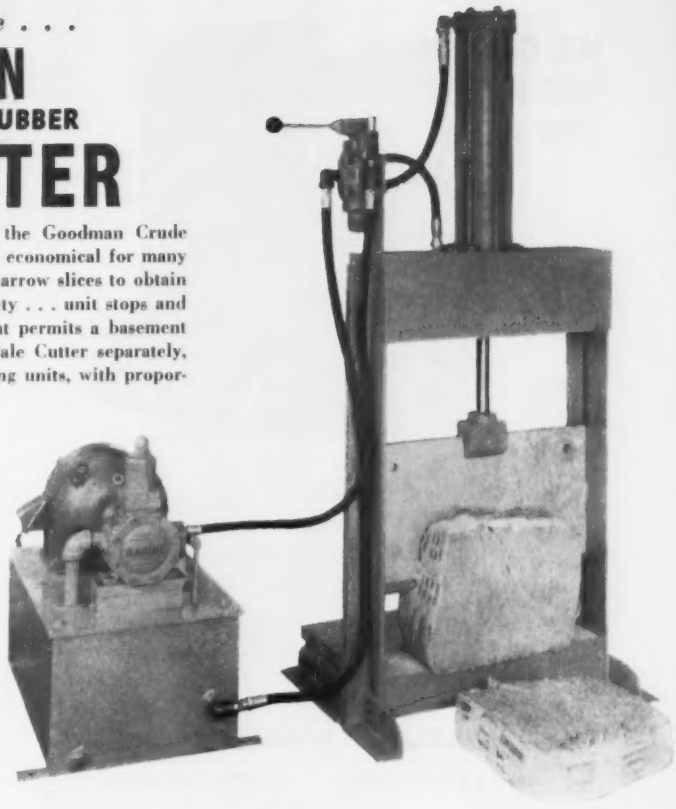

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- ★ Designed for Maximum Safety
- ★ Unbreakable Blade Easily Adjusted
- ★ Cuts Frozen Bales and Narrow Slices

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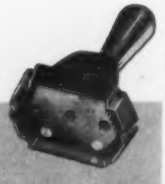

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NAEF Punch Press

► The Model B NAEF manual punch press, distributed in the United States by SMS Instrument Co., P. O. Box 585, Summit, N. J., is designed to accommodate dies with an expulsion following exactly the shape of the specimen. The product and waste materials are knocked out with each

release of the press arm. The press accommodates dies with a lineal cutting edge of up to 40 inches. The die holder has an 8-inch diameter and is designed as a chuck with two jaws, which are operated by a knurled disc. Smaller dies are fastened by moving the jaws towards the center, larger dies by moving the jaws outwardly. Due to the lever ratio and the quality of the gear segments, operation of the press is said to require little manual effort for a relatively high ram pressure. Dimensions of the machine are 23 inches high, 15 inches wide and 16 inches deep. Additional equipment includes stroke counter, depth gage and dies to customer's specification (ASTM dimensions are in stock).

Differential Pressure Indicator

► Aircraft Porous Media, Inc., Glen Cove, N. Y., has announced a new device, tradenamed Deltadyne, which is designed to raise a red button to view when the differential pressure in a system exceeds a stated value. The unit is activated by differential pressures as small as 5 psi in systems with internal pressures as high as 5000 psi. The 1 x 1¾ x 2-inch device can be used to detect clogging, excessive pressure drop, or insufficient or excessive flow.

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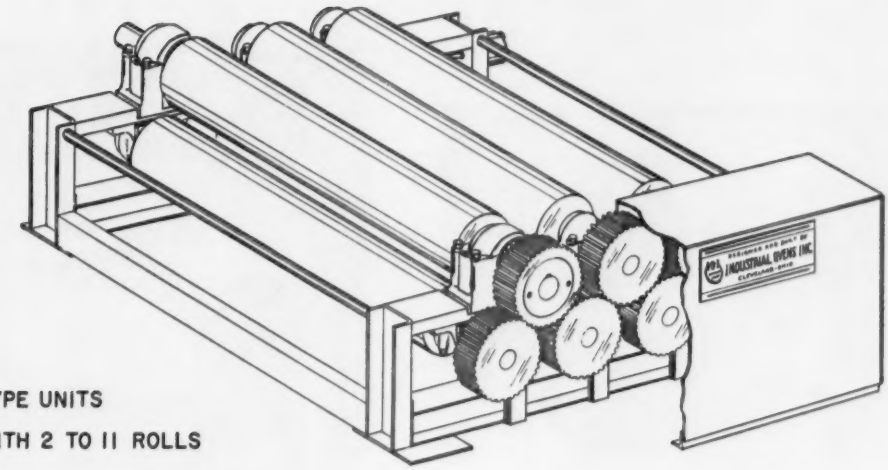

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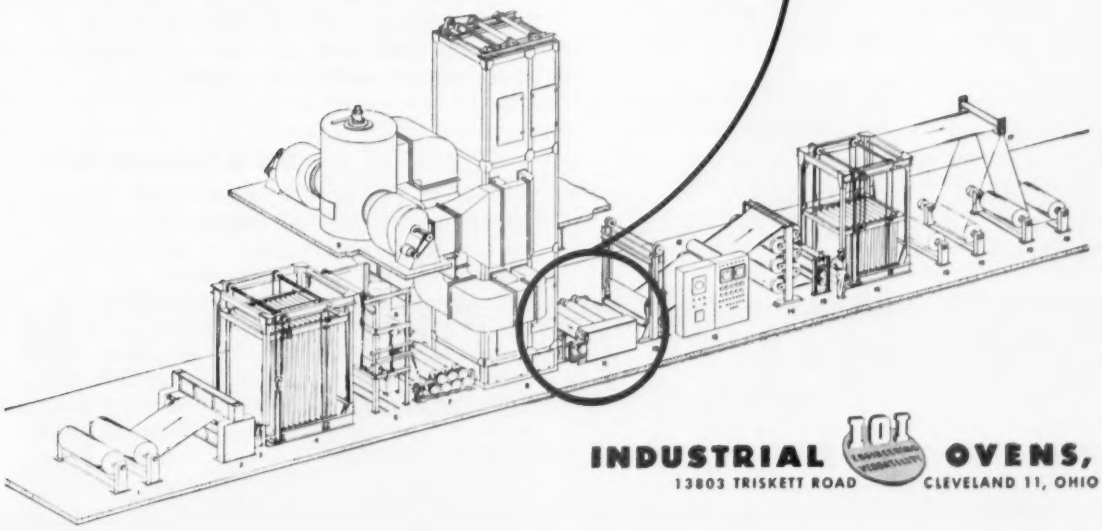

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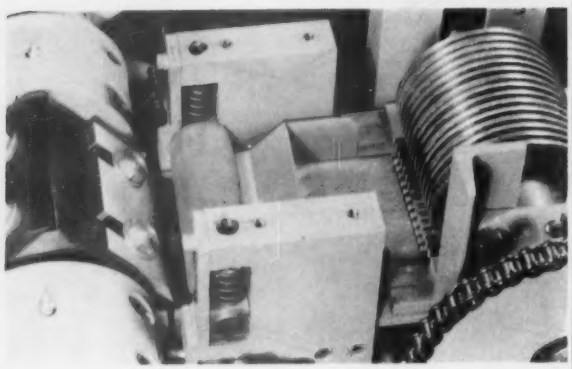

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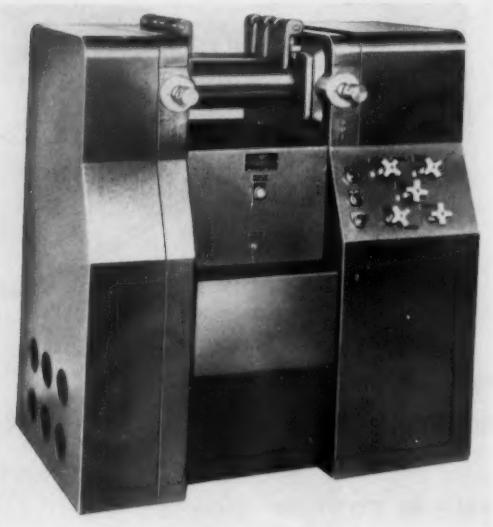
JMC Laboratory Roll Mill

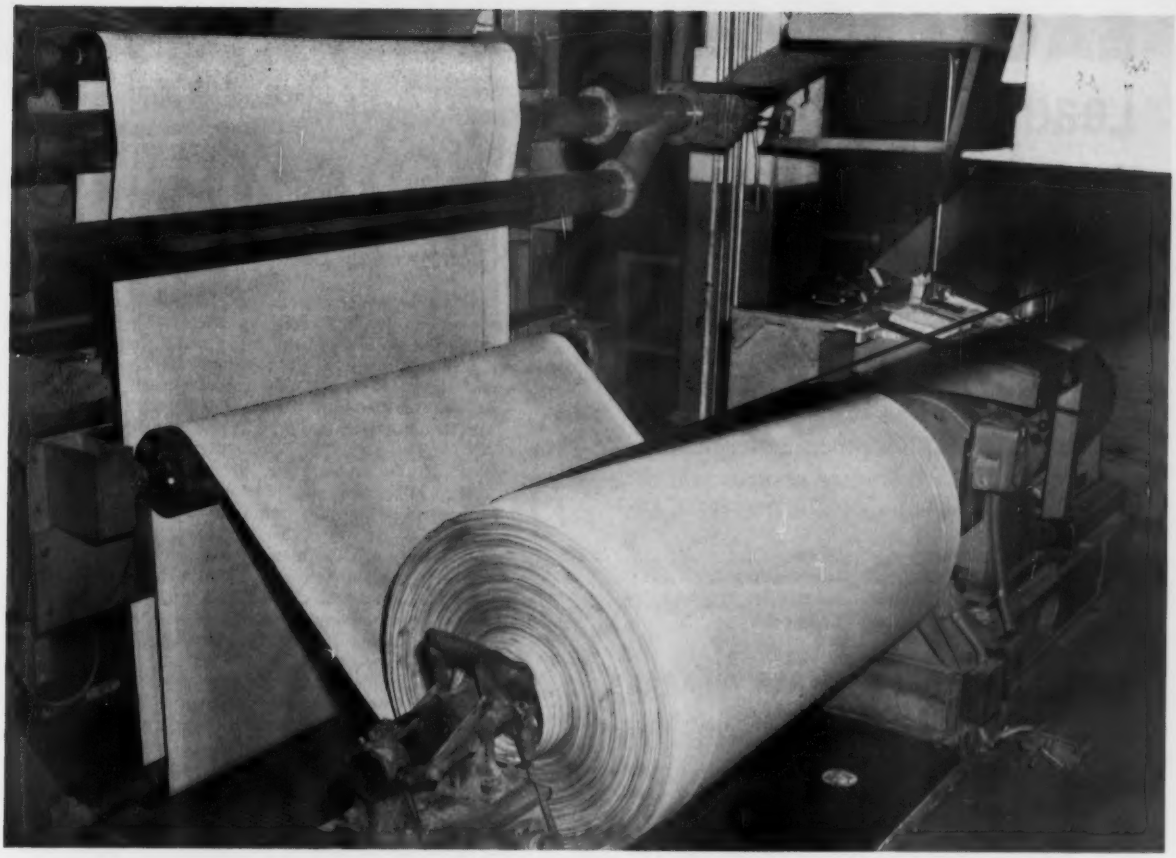
► JMC, 683 Frelinghuysen Ave., Newark, N. J., produces a 6 x 13-inch, 2-roll laboratory mill with 4-inch bearings. The manufacturer says that these bearings, reported to be the largest used in this type machinery, assure a sturdier roll with less roll deflection. The mill has cast steel top cap



frames to hold bearing boxes and rolls and automatic tilt type check plates to facilitate cleaning of rolls and prevent color contamination. Automatic pressure lubrication to journal boxes and automatic drip lubrication to chain drive and connecting gears are said to eliminate the possibility of burning out moving parts. The factory can also provide oil circulating temperature controls to heat the rolls up to 450°F. The mill is driven by a 7½ hp, 3 phase, 60 cycle, 220/440 volt ball bearing motor and gear drive. The motor and roller chain drive provide a back roll speed of 30 rpm and are fully enclosed in the base.

Blue M Convection Ovens

► Blue M Electric Co., Blue Island, Illinois, manufactures a series of mechanical convection ovens which features a range of 104° to 356°F. with an accurate control performance of ±2°C. Ten Test-All bench models with from 1.5 to 24-foot capacity are available in addition to ten equivalent standard floor models. Construction specifications encompass a stainless steel interior including the inside face of the door; heavy gauge steel exterior; and a minimum of 3-inch thick Fiberglas insulation. Controlled velocities range from 50 to 250 fpm. All wiring is complete and enclosed.



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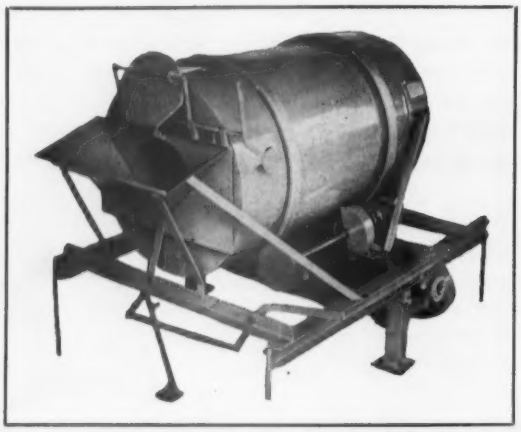

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Reviews

Rubber. By Ir. A. van Rossem. Published by Servire, The Hague, Holland. 6 x 9¼ in. 170 pp. f 8.90 (Approximately $2.32). (In Dutch).

Dr. van Rossem, retired professor of the Technical University of Delft, former director of the Netherlands Government Rubber Institute for more than 30 years, and former director of the Research Department of the Rubber Foundation at Delft, is undoubtedly one of the world's authorities on the subject of rubber.

The author says in his preface that it would have been easier for him to write a book two or three times the volume of the present one, but, nevertheless, he has succeeded in his own careful way in writing a very complete treatise on the subject in a small volume. Although technology of natural rubber forms the backbone, a fair amount of space is given to the synthetic elastomers.

The 170 pages are divided into 12 chapters: History, Plantation, Latex, Chemical Compositions, Physical Properties, Processing, Vulcanization, Manufacturing Using Dry Rubber Processing, Manufacture of Articles from Latex, Properties of Vulcanizates as a Function of the Composition of Mixes, Durability, Statistical and Economical Considerations. Twenty-three photographic and over forty printed illustrations are in the text. A list of reference books is also added.

This excellent little book gives as thorough and clear a story as can be condensed in a volume of this size. The author mentions in the preface that the book can be handled by anyone with a complete high school background, except for the passages on the chemistry of rubber. This may be somewhat optimistic in some respects, but anybody reading this book with interest will enjoy it and benefit.—*B. B. Boonstra.*

•

Technical Editing. Edited by B. H. Weil. Published by Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. 5 x 7½ in. 278 pp. $5.75.

The constantly accelerating output of technical writing over the past years has resulted in a new group of technical professionals known as "technical editors." This new book is intended primarily for these people to aid them in their basic function—presentation of technical writing with a maximum of clarity and communication impact. However, many in the technical and scientific fields other than the editor *per se* will find information of value in this volume.

The book contains papers by the editor and 20 contributing authors. They were originally presented at a "Symposium on Technical Editing" at a meeting of the Division of Chemical Literature of the American Chemical Society. Their subjects cover a wide range, and deal specifically with editing of different technical works: reports, papers and articles; organization-sponsored magazines and newsletters; patents; technical abstracts; society journals; news releases; books; equipment manuals, and translations.

Other papers deal with different aspects of the field: training the technical editor; editing slides and other graphic aids; editing tabular data. One chapter is titled "Editing Know-How—Techniques and Tools." Dealing with such basics as grammar, style, mechanics and reference works, it contains information of great value, particularly to those who are not professionals in the technical editing field but who need information on the subject.

Together the authors present a comprehensive survey of the problems and functions of the technical editor. The book is a welcome addition to the science bookshelf.

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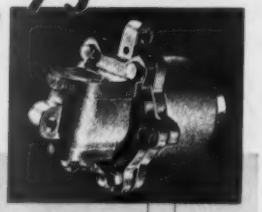

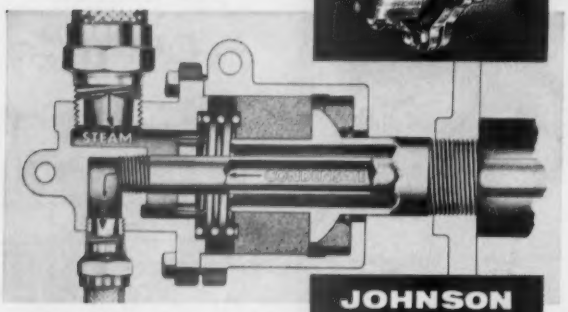

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BOOKLETS, CATALOGS, etc.

E-M Synchronizer. Published by Electric Machinery Mfg. Co., 800 Central Ave., Minneapolis 13, Minn. 8½ x 11 in. 28 pp.

Electrical motors for application on rubber manufacturing machinery are discussed at length in this publication. Several facets of the rubber industry are, however, presented in a more general way. The booklet opens with an analysis of the general characteristics of rubber and its historical development. The making of a tire is illustrated both by a schematic diagram and a short picture story. Other articles include one on application of large ac motors to rubber mill drives, the author giving extensive data on relation of the weight of a batch to recommended horsepower and similar subjects. Reclaiming rubber is also discussed at length, the process being explained fully and information given on the machines used. Closing articles are on "Preventive Maintenance of Large Electric Motors and Controls in Rubber Mills," and "The Cage Winding," the latter being an extended discussion of the unit which exerts the most important torque in starting synchronous motors. This bulletin contains detailed information of value on motors and their controls as applied to the manufacture of rubber.

•

Phillips 66 Hydrocarbons and Sulfur Chemicals. (Bulletin No. 518). Special Products Division, Phillips Petroleum Co., Bartlesville, Okla. 8½ x 11 in. 138 pp.

The fifth edition of this catalog contains data on the many hydrocarbon products supplied by Phillips. Information on a great number of materials is presented succinctly in tabular form. This includes specifications of research and pure grades of each material, comments on other components, listings of typical properties, shipping information and remarks. Many of the materials are used in rubber compounding, for example, various disulfides and hexanes, isobutylene, isoprene, and numerous mercaptans and polysulfides. The closing pages are devoted to test methods for hydrocarbons and ASTM tests. In addition to new products included in the presentation there is a list of other chemicals currently supplied in limited quantities.

•

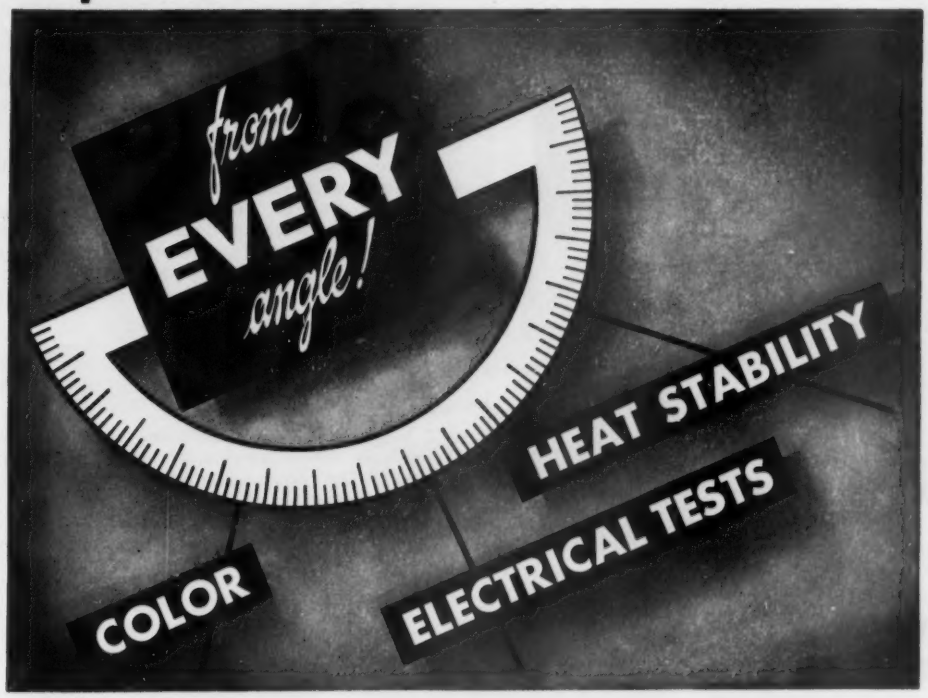
Huber Aerfloted Clays for the Rubber Industry. J. M. Huber Corp., 100 Park Ave., New York 17, N. Y. 8½ x 11 in. 12 pp.

This brochure details the physical and chemical properties of three brands of clay used as fillers in rubber—Suprex, Paragon and Hi-White R. Recipes for inclusion of each of these in styrene rubber, neoprene and natural rubber are given. Both graphs and tables are used to show the differences in physical properties produced by each. A closing page summarizes the meaning of the extensive data as they affect a choice of clay in compounding.

•

Solithane 113. Thiokol Chemical Corp., Trenton 7, N. J. 8½ x 11 in. 4 pp.

A liquid urethane prepolymer, tradenamed Solithane 113, designed for use in compounding elastomeric, semi-rigid and rigid plastics, is described in this brochure. The structure of the material is indicated, and typical properties described. Storage and handling characteristics, and viscosity properties are also given. Processing is discussed under two headings, for casting applications and for coating applications. The extreme versatility of the product is emphasized.



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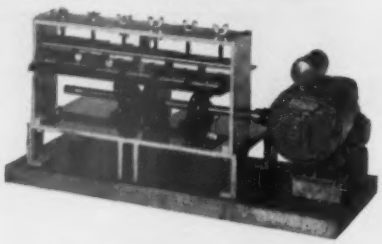
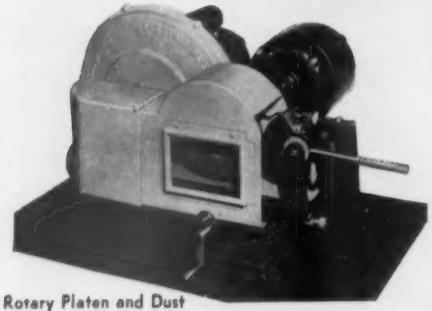


RUBBER SAMPLE BUFFING MACHINE



(Shown with Rotary Platen and Dust Collector with Suction Blower.)

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REVIEWS (CONT'D)

Latex Accelerator Study: Hevea-SBR 2105 Blends. (Bulletin S-147). Industrial Chemicals Division, Pennsalt Chemicals Corp., 3 Penn Center, Philadelphia 2, Penna. 8½ x 11 in. 6 pp.

An investigation of the effects of various accelerators in a blend of natural and styrene rubber latices is reported in this bulletin. The formula for a blend containing 50 parts of each is given, experimental procedures are described, and the effects of eight individual accelerators on physical properties and on viscosity and precure are detailed. The physical test data are given for compounds cured at three different temperatures for various lengths of time, before and after aging of the vulcanizate. A summary of the results for the compound and accelerators tested is presented in text form.

•

Resins for the Rubber Industry. Schenectady Resins Division, Schenectady Varnish Co., Inc., Schenectady 1, N. Y. 8½ x 11 in. 30 pp.

This booklet is divided into two parts, one devoted to resins for rubber compounding and one to resins for adhesives. The former opens with a discussion of how the products are used in the rubber industry. Following is a two-page discussion of general technical information with data on compounding techniques and related subjects. A large application chart presents facts on use of various resins in natural rubber and in three synthetics, with details on the resin characteristics and typical applications. Four phenolic resins, their properties, and uses in rubber, are then analyzed fully.

•

Phillips Rubber Research. Phillips Petroleum Co., Bartlesville, Okla. 8½ x 11 in. 26 pp.

This four-color booklet, lavishly illustrated with photographs and drawings, tells the story of polymerization research at Phillips Petroleum Co. It is divided into four main sections, the first being an introduction in which the company's original research facilities are described. This is followed by parts on polymerization research, pilot plant development, and research compounding and technical service. Most of the story is told by the photographs and their captions, text being held to a minimum.

•

Catalin Antioxidants. Catalin Corp. of America, One Park Ave., New York 16, N. Y. 8½ x 11 in. 12 pp.

This booklet opens with a technical discussion of the oxidation mechanism through free radical action. Following are detailed descriptions of four of the firm's antioxidant chemicals, with information on their application in rubber, plastics and other materials. Laboratory data are provided on physical and chemical properties as well as effectiveness of the antioxidants. Included is a recipe showing how one of the products can be used in natural rubber as a non-staining antioxidant. Graphs are used to portray the extensive technical data.

•

Le-Hi Hose Accessories Catalog. (Condensed Catalog No. 34). Hose Accessories Co., 2704 North 17th Street, Philadelphia 32, Penna. 8½ x 11 in. 8 pp.

This catalog contains essential information on a wide variety of hose couplings and fittings for every type of industrial hose. A photographic illustration is used to show each of the items. Text gives recommended uses, a description of the item, and data on sizes, materials and related subjects. Many different types of couplings, clamps, manifolds, valves, nipples and other items are shown.

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Perhaps it's just as well that this runabout, designed about 1915, never got into mass production. No one could have believed it . . .

But the vehicle had practical and ingenious features despite its awkward appearance. Actually a converted motorcycle, its chassis was made of steel tubes which could be taken apart and carried in a bundle. A contemporary description said that "the body affords almost luxurious accommodations for two, is provided with a windscreen and excellent folding top."

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KOSMOS 20 SRF — Excellent for highly loaded rubber goods; easy and cool mixing; semi-reinforcing; low in heat generation; high in resilience.

KOSMOBILE 77 EPC — Recommended for good processing, for high level of reinforcement, high tensile strength, good resistance to abrasion.

KOSMOBILE S-66 MPC — For rubber goods requiring high reinforcement, high tensile strength, highest resistance to tear and good resistance to abrasion.

KOSMOS BB (Voltex) CC — Ideal in polyethylene for resistance to ultraviolet radiation; for coloring of plastics and for high electrical conductivity.

UNITED CARBON COMPANY, INC.

A subsidiary of United Carbon Company

CHARLESTON 27, WEST VIRGINIA

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IN CANADA: CANADIAN INDUSTRIES LIMITED

60 GRADES AND GRINDS MEET EVERY SULFUR NEED

PROCESSED CRUDE SULFURS
All grades 99.5% pure in sizes from 325-mesh to mixed fines and lumps.

REFINED INDUSTRIAL SULFURS
Grades range in fineness from 200-mesh through cones, sticks, lumps, solid barrels, all 99.85% minimum pure.

DISPERSED SULFUR
An aqueous dispersion, 68% sulfur, of particles averaging less than 2 microns in diameter.

RUBBERMAKERS' SULFURS
Specially formulated and standardized for tires, tubes and rubber specialties. Pure sulfur content from 68% (dispersed) to 99.8%. Sizes from 80- to 325-mesh.

CRYSTEX® INSOLUBLE SULFUR
Stauffer's insoluble sulfur, "Crystex", is a thermoplastic high polymer with a molecular weight in the order of hundreds of thousands. At least 85% of this material is insoluble in uncured rubber . . . does not migrate . . . eliminates "bloom".

AGRICULTURAL SULFURS
Among many grades are Dusting, Wettable, Dip and Coarse sulfurs for a wide variety of agricultural and livestock uses.

Stauffer is the country's largest user of sulfur and largest marketer of processed sulfurs.

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STAUFFER CHEMICAL COMPANY

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Stauffer CHEMICALS SINCE 1885

MARKET REPORTS

TRENDS
NEWS
PRICES

Natural Rubber

Since our last report (February 2), the price of natural rubber on the New York Commodity Exchange has moved in a range of 75 points, high for the period being 30.63c reached on February 6, and low being 29.88c reached on February 2. The average price of spot rubber for the month of February was 30.26c based on 18 trading days. This compares with an average of 30.34c in the month of January.

The Soviet Union has again surprised the world rubber market, this time with a sudden display of heavy interest in Malayan rubber. The "hit-and-run" technique employed by the Soviet Union, coming into the market at low price levels, and withdrawing when strength develops, has kept American consumers guessing about future trends.

A few weeks ago, the Soviet Union seemed headed in the opposite direction when she purchased 4,000 tons of synthetic rubber from Italy, with a reported option on 4,000 tons more.

Estimated purchases of natural rubber by the Soviet Union in 1958 came to 182,500 long tons, compared with only 77,500 long tons in 1957 and 126,000 in 1956. Judging from the two-year industrial expansion program publicized by the Soviet Union, that country's rubber requirements in the immediate future will be greatly enlarged.

Eastern Bloc Consumption

Consumption figures are not readily available, but estimates for the Eastern European bloc in the first ten months of last year run to 227,700 long tons. In 1956, these countries absorbed 208,700 long tons while in 1957 they consumed 166,750 long tons.

Soviet rubber purchases have become a vital part of the economy for at least three rubber producing nations in Southeast Asia which are in delicate financial condition. So far this year the Soviet Union has restricted purchases to small amounts ranging between 500 and 1,000 tons, with particular emphasis on the lower grades. Last year, the stress was on top quality natural.

Influence on Prices

Many traders are predicting that further price increases in natural rubber can be expected if Russian demands remain equal to 1958. From latest reports, however, Soviet rubber purchases in 1959 may well exceed the 1958 level.

Considering the tight supply-demand picture predicted over the next two years, any increase in demand is likely to affect prices bullishly. If prices cross the 31c per pound level, many analysts estimate that the rise could carry to 32c and possibly as high as 34c a pound. The possibility of 34c rubber will likely mean further loss of ground to synthetic rubber.

NEW YORK, MARCH 2, 1959

Price Data

Closing Rubber Prices on New York Commodity Exchange

FROM FEB. 1 TO FEB. 28

Feb.	Spot	Mar.	May	July	Sales
1	....	....	....	....	...
2	29.88	29.85	29.85	29.85	17
3	30.13	30.30	30.25	30.25	34
4	30.38	30.40	30.47	30.40	39
5	30.25	30.25	30.27	30.27	20
6	30.63	30.60	30.60	30.60	53
7	....	....	....	....	...
8	....	....	....	....	...
9	30.38	30.50	30.55	30.55	67
10	30.38	30.25	30.35	30.35	40
11	30.50	30.35	30.37	30.40	23
12	....	....	....	....	...
13	30.13	30.25	30.25	30.25	31
14	....	....	....	....	...
15	....	....	....	....	...
16	30.00	30.10	30.15	30.18	14
17	30.25	30.30	30.30	30.25	22
18	30.25	30.35	30.35	30.40	30
19	30.13	30.15	30.25	30.25	12
20	30.25	30.28	30.40	30.40	29
21	....	....	....	....	...
22	....	....	....	....	...
23	....	....	....	....	...
24	30.25	30.48	30.50	30.50	39
25	30.25	30.40	30.50	30.50	75
26	30.25	30.40	30.50	30.55	50
27	30.38	30.55	30.65	30.70	36
28	....	....	....	....	...

Outside Market

No. 1 Ribbed Smoked Sheets:	
Spot	.30⅜
Apr.	.30½
May	.30½
Thin Latex Crepe:	
Spot	.32
Thin Brown Crepe, No. 2	.29
Flat Bark Crepe	.26

London Market
(Standard Smoked Sheets)

Apr.-June	30.15 — 30.30
July-Sept	30.30 — 30.44

Singapore Market
(Standard Smoked Sheets)

Apr.	28.85 — 28.93

Middling Upland Quotations

	Feb. 2	February 27		
	Close	High	Low	Close
Mar.	35.15	35.68	35.56	35.53
May	35.28	35.68	35.55	35.58
July	34.23	34.84	34.70	34.72

Notes & Quotes

H. C. Bugbee, president of the Natural Rubber Bureau, notes that "we are in a rapidly expanding world economy sure to need more total rubber than most of us realize. There is no room in such an era for the philosophy of restriction of production or low-yield, high cost units. What is needed is the greatest possible production efficiency. This applies to both natural and synthetic rubber."

Synthetic Rubber

The rubber manufacturing industry in the United States set two new records during the month of January, 1959, according to the Rubber Manufacturers Association. New rubber consumption amounted to 141,020 long tons for a new monthly high, while production of all types of synthetic rubber reached 108,473 long tons in the same period.

The previous peak month for new rubber consumption was January, 1957, with a total of 137,715 long tons. Consumption during December, 1958, was 132,391 long tons. Synthetic rubber consumption for January, 1959, amounted to 90,670 long tons compared with the December figure of 85,428 long tons. Of the total new rubber consumed in January, synthetic rubber accounted for 64.30 per cent against the December ratio of 64.53 per cent.

The Soviet Union Again

There almost seems to be a preoccupation with what the Soviet Union is doing these days, and the field of synthetic rubber is no different than any other. With synthetic rubber capacity expanding in all parts of the world, it is assumed that the Russian industry, if it has been keeping pace with the rest of the world, now has the capacity to produce 700,000 long tons of synthetic rubber annually. It is estimated that consumption in the Soviet Union is in the neighborhood of 1 million long tons.

Under any circumstances, a country with such a large production-consumption potential would constitute a major factor in world markets. Under the Soviet system, however, production-consumption becomes a political weapon of no mean importance.

In our editorial columns this issue we call attention to the beginning of the European common market and the effect it is likely to have upon exports of synthetic rubber from the United States. It would seem, from the facts at hand, that the American producer of synthetic rubber will face major obstacles in competing successfully in European markets.

The Soviet Contribution

Difficulties in competing within the common market may be further compounded if the Soviet Union decides to enter the picture. One can imagine, without too much difficulty, the havoc which cheap Soviet rubber would raise in Western nations. Most countries of the Free World could not meet politically controlled prices.

There have been indications from abroad that the Soviet Union will enter world synthetic rubber markets. Such an action would not only affect Western Europe, the United States and Canada, but the natural rubber producing nations of the Far East as well. Such a situation, with its global implications, may have to be faced in the foreseeable future.

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(N-cyclohexyl benzothiazole-2-sulfenamide)

Accelerator

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flows freely, won't bridge, isn't dusty

Discover[2] that **CYDAC**
disperses quickly, is ideal in automatic equipment, offers many handling-ease economies, substitutes directly for powdered forms, cures the same, costs no more!

CYANAMID

AMERICAN CYANAMID COMPANY
Rubber Chemicals Department
Bound Brook, New Jersey

*Trademark

[1] CYDAC FLAKED, the only commercial flaked form of the popular N-cyclohexyl benzothiazole-2-sulfenamide is photographed here in actual size.

[2] A phone call, wire or letter to Cyanamid will bring you samples and technical information.

PRICES OF COMMERCIALLY AVAILABLE SYNTHETIC RUBBER

Dry Rubber

(per pound carload)

Butadiene-Acrylonitrile Types

Butaprene NF	.4900 [1]
Butaprene NH	.6500 [2]
Butaprene NL	.5000 [1]
Butaprene NXM	.5800 [1]
Chemigum N1NS	.6400 [2]
Chemigum N3NS	.5800 [2]
Chemigum N5	.5800 [2]
Chemigum N6	.5000 [2]
Chemigum N6B	.5000 [2]
Chemigum N7	.5000 [2]
Caemigum N8	.5000 [2]
Chemigum N600	.5000 [2]
Herecol N-33	.6800 [2]
Hycar 1001	.5800 [2]
Hycar 1002	.5000 [2]
Hycar 1014	.6000 [2]
Hycar 1041	.5800 [2]
Hycar 1042 and 1043	.5000 [2]
Hycar 1312	.5000 [2]
Hycar 1411	.6200 [2]
Hycar 1432	.5900 [2]
Hycar 1441	.6200 [2]
Paracril AJ	.4850 [2]
Paracril ALT	.5000 [2]
Paracril B and BJ	.5000 [2]
Paracril BLT and BJLT	.5000 [2]
Paracril C and CLT	.5800 [2]
Paracril CV	.5900 [2]
Paracril D	.6500 [2]
Paracril 18-80	.6000 [2]
Paracril OZO	.4600 [2]
Polysar Krynac 800	.5000 [2]
Polysar Krynac 801	.5800 [2]
Polysar Krynac 802	.5000 [2]
Polysar Krynac 803	.5000 [2]

Butadiene-Styrene Types

Ameripol 1000	.2410 [2]
Ameripol 1001	.2410 [2]
Ameripol 1002	.2435 [2]
Ameripol 1006	.2410 [2]
Ameripol 1006 (crumb)	.2475 [2]
Ameripol 1007	.2410 [2]
Ameripol 1009	.2475 [2]
Ameripol 1009 (crumb)	.2590 [2]
Ameripol 1011	.2475 [2]
Ameripol 1012	.2425 [2]
Ameripol 1012 (crumb)	.2490 [2]
Ameripol 1013	.2500 [2]
Ameripol 1013 (crumb)	.2615 [2]
Ameripol 1500	.2410 [2]
Ameripol 1501	.2410 [2]
Ameripol 1502	.2410 [2]
Ameripol 1703	.2060 [2]
Ameripol 1705	.2035 [2]
Ameripol 1707	.1910 [2]
Ameripol 1708	.1910 [2]
Ameripol 1710	.1885 [2]
Ameripol 1712	.1885 [2]
Ameripol 4600	.2410 [2]
Ameripol 4650	.1820 [2]
Ameripol 4651	.1770 [2]
Ameripol 4652	.1425 [2]
Ameripol 4654	.1870 [2]
Ameripol 4655	.1820 [2]
Ameripol 4700	.1750 [2]
Ameripol 4701	.1725 [2]
Ameripol 4750	.1545 [2]
Ameripol 4751	.1400 [2]
Ameripol 4752	.1600 [2]
Ameripol 4753	.1480 [2]
ASRC 1000	.2410 [2]
ASRC 1001	.2401 [2]
ASRC 1004	.2401 [2]
ASRC 1006	.2410 [2]
ASRC 1009	.2475 [2]
ASRC 1018	.2700 [2]
ASRC 1019	.2650 [2]
ASRC 1500	.2410 [2]
ASRC 1502	.2410 [2]
ASRC 1503	.2625 [2]
ASRC 1703	.2060 [2]
ASRC 1708	.1910 [2]
ASCR 3110	.2600 [2]
Baytown 1600	.1930 [2]
Baytown 1601	.1930 [2]
Baytown 1602	.1930 [2]
Baytown 1801	.1760 [2]
Baytown 1803	.1740 [2]
Carbomix 3750	.1820 [2]
Carbomix 3751	.1545 [2]
Carbomix 3752	.1870 [2]
Carbomix 3753	.1640 [2]
Carbomix 3754	.1790 [2]
Carbomix 3755	.1535 [2]
Copo 1500	.2410 [2]
Copo 1502	.2410 [2]
Copo 1505	.2010 [2]
Copo 1712	.1885 [2]
Copo 1773	.2060 [2]
Copo 1778	.1910 [2]
Copo 3900	.2310 [2]
FR-S 123	.1960 [2]
FR-S 127	.2600 [2]
FR-S 141	.2800 [2]
FR-S 146	.2410 [2]
FR-S 154	.1885 [2]
FR-S 155	.1885 [2]
FR-S 158	.3000 [2]
FR-S 173	.2060 [2]
FR-S 178	.1910 [2]
FR-S 179	.2410 [2]
FR-S 181	.2410 [2]
FR-S 1000	.2410 [2]
FR-S 1001	.2410 [2]
FR-S 1004	.2410 [2]
FR-S 1006	.2410 [2]
FR-S 1007	.2410 [2]
FR-S 1009	.2475 [2]
FR-S 1010	.2600 [2]
FR-S 1012	.2425 [2]
FR-S 1013	.2500 [2]
FR-S 1014	.2810 [2]
FR-S 1500	.2410 [2]
FR-S 1502	.2410 [2]
FR-S 1703	.2060 [2]
FR-S 1710	.1885 [2]
FR-S 1712	.1885 [2]
Naugapol 1016	.2650 [2]
Naugapol 1018	.2700 [2]
Naugapol 1019	.2650 [2]
Naugapol 1021	.3000 [2]
Naugapol 1022	.2800 [2]
Naugapol 1023	.2850 [2]
Naugapol 1503	.2625 [2]
Naugapol 1504	.2950 [2]
Philprene 1000	.2410 [1]
Philprene 1001	.2410 [1]
Philprene 1006	.2410 [1]
Philprene 1009	.2475 [1]
Philprene 1010	.2600 [1]
Philprene 1018	.2700 [1]
Philprene 1019	.2650 [1]
Philprene 1100	.1940 [1]
Philprene 1104	.1900 [1]
Philprene 1500	.2410 [1]
Philprene 1502	.2410 [1]
Philprene 1503	.2625 [1]
Philprene 1600	.1930 [1]
Philprene 1601	.1930 [1]
Philprene 1605	.1900 [1]
Philprene 1703	.2060 [1]
Philprene 1706	.2030 [1]
Philprene 1708	.1910 [1]
Philprene 1712	.1885 [1]
Philprene 1803	.1740 [1]
Plioflex 1006	.2410 [2]
Plioflex 1500C	.2410 [2]
Plioflex 1502	.2410 [2]
Plioflex 1507	.2410 [2]
Plioflex 1703	.2060 [2]
Plioflex 1710C	.1885 [2]
Plioflex 1712C	.1885 [2]
Plioflex 1713	.1750 [2]
Plioflex 1714C	.1725 [2]
Plioflex 1773	.2060 [2]
Plioflex 1778	.1910 [2]
Polysar Kryflex 200	.2510 [2]
Polysar Krylene	.2410 [2]
Polysar Krylene NS	.2410 [2]
Polysar Krynol 651	.1885 [2]
Polysar Krynol 652	.1910 [2]
Polysar S	.2410 [2]
Polysar S-50	.2410 [2]
Polysar S-X 371	.2550 [2]
Polysar SS-250	.2875 [2]
S-1000	.2300 [2]
S-1002	.2325 [2]
S-1006	.2300 [2]
S-1009	.2400 [2]
S-1011	.2325 [2]
S-1013	.2300 [2]
S-1100	.1850 [2]
S-1500	.2300 [2]
S-1502	.2300 [2]
S-1506	.2500 [2]
S-1600	.1825 [2]
S-1602	.1825 [2]
S-1703	.1950 [2]
S-1706	.1925 [2]
S-1707	.1800 [2]
S-1709	.1775 [2]
S-1712	.1775 [2]
S-1803	.1650 [2]
S-1804	.1750 [2]
Synpol 1000	.2410 [1]
Synpol 1001	.2410 [1]
Synpol 1002	.2435 [1]
Synpol 1006	.2410 [1]
Synpol 1007	.2410 [1]
Synpol 1009	.2475 [1]
Synpol 1012	.2425 [1]
Synpol 1061	.2410 [1]
Synpol 1500	.2410 [1]
Synpol 1502	.2410 [1]
Synpol 1551	.2410 [1]
Synpol 1703	.2060 [1]
Synpol 1707	.1910 [1]
Synpol 1708	.1910 [1]
Synpol 1711	.1900 [1]
Synpol 1712	.1885 [1]
Synpol 8000	.2410 [2]
Synpol 8150	.1930 [2]
Synpol 8200	.1910 [2]
Synpol 8201	.1750 [2]
Synpol 8250	.1740 [2]
Synpol 8253	.1584 [2]
Synpol 8254	.1545 [2]
Synpol X 274	.2550 [2]

Butyl Rubbers

Enjay Butyl 035 and 150	.2300 [2]
Enjay Butyl 165 NS	.2400 [2]
Enjay Butyl 215	.2300 [2]
Enjay Butyl 217	.2300 [2]
Enjay Butyl 218	.2300 [2]
Enjay Butyl 268 NS	.2400 [2]
Enjay Buty 325	.2300 [2]
Enjay Butyl 365 NS	.2400 [2]
Polysar Butyl 100	.2450 [2]
Polysar Butyl 101	.2775 [2]
Polysar Butyl 200 and 300	.2450 [2]
Polycar Butyl 301	.2550 [2]
Polysar Butyl 400	.2450 [2]

Chlorosulfonated Polyethylene

Hypalon 20	.7000 [2]
Hypalon 30	.7000 [2]

Neoprene

	(prices l.c.l.)
Neoprene Types AC and CG	.5500 [2]
Neoprene Type AD	.5500 [2]
Neoprene Type FB	.6500 [2]
Neoprene Type GN	.4100 [2]
Neoprene Type GN-A	.4100 [2]
Neoprene Type GRT	.4200 [2]
Neoprene Type KNR	.7500 [2]
Neoprene Type S	.4200 [2]
Neoprene Type W	.3900 [2]
Neoprene Type WB	.4100 [2]
Neoprene Type WHV	.3900 [2]
Neoprene Type WRT	.4500 [2]
Neoprene Type WX	.4100 [2]

Polysulfide Rubbers

	(prices l.c.l.)
Thiokol Type A	.5000 [2]
Thiokol Type FA	.6900 [2]
Thiokol Type ST	1.2500 [2]

Silicone Rubbers*

	(prices l.c.l.)
GE (compounded)	2.50 [2]
GE Silicone Gum (not compounded)	4.00 [2]
Silastic (compounded)	1.90 [2]
Silastic (gums)	3.85 [2]
Union Carbide (gums)	4.00 [2]
Union Carbide (compounds)	2.50 [2]

Latex

(per pound carload)

Butadiene-Acrylonitrile Types

Butaprene N-300	.4600 [1]
Butaprene N-400	.5400 [1]
Butaprene N-401	.5400 [1]
Chemigum 200	.4900 [2]
Chemigum 235	.5400 [2]
Chemigum 236	.5400 [2]

POLYMERS

Butadiene-Styrene Types

Chemigum 245	.4600	3
Chemigum 246	.4600	3
Chemigum 247	.4600	3
Chemigum 248	.4600	3
Hycar 1512	.4600	3
Hycar 1551	.5400	3
Hycar 1552	.4600	3
Hycar 1561	.5400	3
Hycar 1562	.4600	3
Hycar 1571	.5400	3
Hycar 1572	.5100	3
Hycar 1577	.4600	3
Hycar 1852	.4600	3
Nitrex 2612	.4600	1
Nitrex 2614	.4600	1
Nitrex 2614-A	.4600	1
Nitrex 2515	.5100	1
Nitrex 2615-A	.5100	1
Nitrex 2616	.5400	1
Nitrex 2617	.4600	1
Nitrex 2617-A	.4600	1
Nitrex 2619	.5300	1
Nitrex 2620	.4600	1
Nitrex 2625	.4600	1
Copo 2101	.3000	3
Copo 2102	.3200	3
Copo 2105	.3200	3
Copo 2108	.3375	3
Copo 2110	.3200	3
Copo X-800	.2775	3
FR-S 2000	.2775	3
FR-S 2001	.2775	3
FR-S 2002	.3000	3
FR-S 2003	.3050	3
FR-S 2004	.3050	3
FR-S 2006	.2900	3
FR-S 2105	.3200	3
Naugatex 2000	.2775	1
Naugatex 2001	.2775	1
Naugatex 2002	.3000	1
Naugatex 2006	.2900	1
Naugatex 2105	.3200	1
Naugatex 2107	.3200	1
Naugatex 2108	.3000	1
Pliolite 2000	.2775	3
Pliolite 2001	.2775	3
Pliolite 2076	.2900	3
Pliolite 2104	.3200	3
Pliolite 2105	.3200	3
Pliolite 2107	.3200	3
Pliolite 2108	.3000	3
S-2000	.2275	3
S-2006	.2150	3
S-2101	.2250	3
S-2105	.3100	3
S-2107	.3200	3

Neoprene

Neoprene Latex 60	.4000	3
Neoprene Latex 571	.3700	3
Neoprene Latex 572	.3900	3
Neoprene Latex 601-A	.4000	3
Neoprene Latex 673	.5000	3
Neoprene Latex 735	.3800	3
Neoprene Latex 736	.3800	3
Neoprene Latex 842-A	.3700	3
Neoprene Latex 950	.4700	3

Polysulfide Rubbers

Thiokol Type MX	.8000	3
Thiokol Type WD-2	1.2500	3
Thiokol Type WD-6	.8000	3

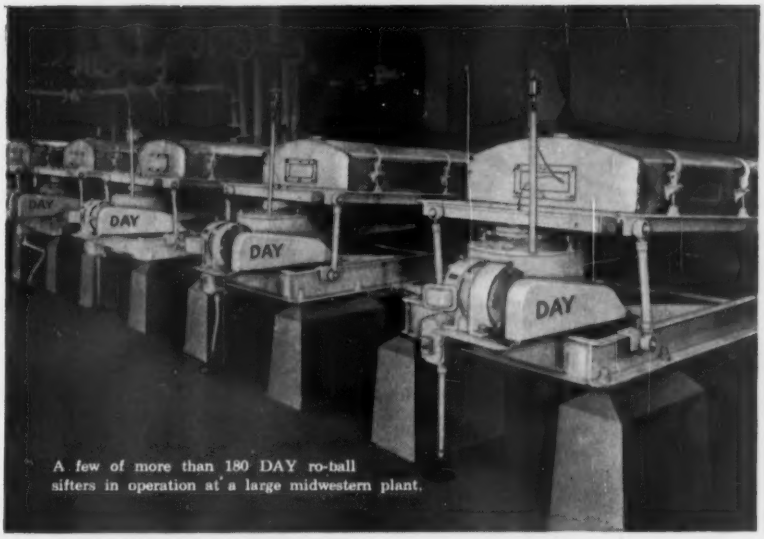
Notes: (1) Freight allowed. (2) Freight extra. (3) Freight prepaid. *Covers a wide range of compounds. Readers are urged to check specific prices with producers.

SUPPLIERS

Are Your Synthetic Rubbers Listed in This Section? if not Forward full information to

Market Editor
RUBBER AGE
101 West 31st St., New York 1, N. Y.

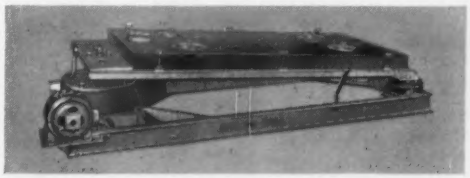
SIFT finer-faster-cleaner with DAY ro-balls

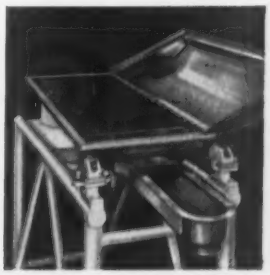


A few of more than 180 DAY ro-ball sifters in operation at a large midwestern plant.

Today thousands of products wet or dry, from flour to wood chips, are sifted through efficient, low-cost, high-production DAY ro-ball sifters. Superbly engineered, built for trouble-free operation under the severest service conditions, they insure longer life with lower maintenance costs.

The exclusive super active ball cleaning device provides rebound points in each ball compartment, assuring fast, thorough sifting of your product. Gyrating action brings material into constant contact with every square inch of screen surface. A stabilizer maintains screen in horizontal position and insures smooth operation.


DAY standard ro-ball, available in six sizes, single or multiple screens. Single screen models in stock.


Stainless steel units available to meet food and dairy sanitary codes.

Many models are available so it is easy to choose one which will exactly suit your requirements. They can be used separately or in combination with DAY mixers or blenders to save product handling. A completely equipped lab is available for testing your product.

Write for new DAY ro-ball Bulletin.

The **J. H. DAY** *Co.*

Division of The Cleveland Automatic Machine Co.

SERVING THE PROCESS INDUSTRY SINCE 1887

4918 BEECH STREET, CINCINNATI 12, OHIO

MARKETS

(continued)

Reclaimed Rubber

The Rubber Manufacturers Association reports that 25,250 long tons of reclaimed rubber were produced in January of this year against the 21,945 long tons produced in January, 1958. Thus, the new year began in rather an auspicious manner for the reclaimed rubber industry, for if production were to continue in this pattern for the balance of the year, a total of some 300,000 long tons will be turned out.

Consumption also started well, with 24,300 long tons of reclaimed rubber used in January, 1959, compared with the 21,186 long tons used in January of the previous year. As of January 31, 1959, there were 28,000 long tons of reclaimed rubber in stocks, this sum being equal to approximately one month's consumption.

Accelerated production-consumption of reclaimed rubber reflects, of course, heightened activity in the automobile industry. If automobile output continues on the high side, reclaimed rubber will, accordingly, profit. At any rate, 1959 seems to be shaping up as a better year than its predecessor.

(Prices for All Areas Except Calif.)

	per lb.
Premium Grade Whole Tire	.11¼
First Line Whole Tire	.11
Second Line Whole Tire	.10½
Third Line Whole Tire	.10¼
Fourth Line Whole Tire	.09¾
Black Carcass	.15½
No. 1 Light Colored Carcass	.22
No. 1 Peel	.11
Butyl Tube Reclaim	.14
Natural Rubber Black Tube	.16
Natural Rubber Red Tube	.21
Natural Rubber Gray Tube	.21

Scrap Rubber

An easier tone has pervaded the scrap rubber market during the past few weeks, though reclaimers are said to have cut down on the size of their orders somewhat. There has been little change in the tire section of the market. However, tubes have been weaker. In all, the market reflects the degree of increased activity noted in the general economy.

The Rubber Manufacturers Association notes that 23,608 long tons of scrap rubber were consumed in the United States in January. As of January 31, 1959, there were 55,683 long tons of scrap rubber in stocks. This is equal to about two month's consumption at current usage rates.

(Prices Delivered Akron)

Mixed tires	ton	14.00
Light colored carcass	lb.	.04¾
No. 1 peelings	ton	28.00
No. 2 peelings	ton	25.00
No. 3 peelings	ton	21.00
Buffings	ton	16.00
Truck and Bus S.A.G.	ton	20.00
Passenger S.A.G.	ton	17.00
Natural Rubber Red Tubes	lb.	.07¼
Natural Rubber Black Tubes	lb.	.06½
Butyl Rubber Tubes	lb.	.05½

Tire Fabrics

Results of a series of tests on nylon, rayon and Tyrex viscose tire cord were announced recently by William Dalton, president of Tyrex Inc., at the annual convention of the National Automobile Association. Conducted by an independent research organization, tests are said to have shown that Tyrex has 24 per cent greater tread mileage than nylon. Viscose cord tires also showed 1/3 of the growth developed by nylon and only negligible groove cracking as against considerable groove cracking found by test engineers in nylon tires.

Chunking Out Analyzed

In other tests, "chunking out" characteristics of rayon, nylon and the new viscose tire cord were analyzed. The term "chunking out" refers to situations where chunks of rubber are torn from tires at high speeds, because the rubber "crawls" along the tire cord casing and is torn apart by the momentum of the auto wheels. Mr. Dalton said that these tests showed that nylon tires "chunk out" four times more at high speeds than those made with Tyrex viscose cord.

A third series of tests was conducted to show impact resistance of rear passenger tires made with different casing materials. In terms of breaks per 10,000 tire miles, Mr. Dalton said, the test results showed the following breakdown: One set of tires made with Tyrex viscose cord tires, five breaks; another set of viscose cord tires, three breaks; a set of rayon cord tires, 13 breaks and a set of nylon cord tires, 15 breaks.

Decreased Rayon Shipments

The February issue of *Textile Organon* states that total deliveries of viscose plus cupramonium rayon filament yarns, in going off from 496,600,000 pounds to the 1958 total of 429,500,000 pounds, incorporated declines in total textile uses, tires and related uses, and the export trade. There was a reduction of 18 per cent in shipments to the tires and related uses trades and a two per cent decrease in "textile" yarn deliveries.

(Prices f.o.b. Shipping Point)

Rayon Tire Cord

1100	lb.	.73
1650	lb.	.67
2200	lb.	.67½

Nylon Tire Cord

210	lb.	1.96
840	lb.	1.70

Rayon Graded Fabric

1100	lb.	.69
1650	lb.	.63¼
2200	lb.	.63

Cotton Chafers

8.9 oz. (per square yard)	lb.	.71
9.25 oz. (per square yard)	lb.	.69
11.65 oz. (per square yard)	lb.	.63
14.4 oz. (per square yard)	lb.	.72

Liquid Latex

Natural: The new year started for the natural latex consumption with the importation of 6,565 long tons in January, according to the Rubber Manufacturers Association. This figure compares with the 6,115 long tons imported in January, 1958, and the difference of some 400 long tons is indicative of the greater market activity which the new year seems to have brought.

In January of this year, RMA states, 7,200 long tons were consumed, or approximately 400 long tons more than were consumed in January of the preceding year. As of January 31, 1959, there were 9,900 long tons of natural latex in stocks on hand.

Natural rubber latex is currently selling at a 37 to 38c per pound level at East Coast ports in car load lots. As a matter of fact, natural latex prices have held firm during the past several months and give every indication of remaining so in the immediate future.

Synthetic: What with increased activity in synthetic rubber generally, the synthetic latex segment is expected to do rather well in 1959. Many in the trade believe that the demand for natural latex may not be met by available supplies. Under these circumstances, synthetic latex cannot help but benefit.

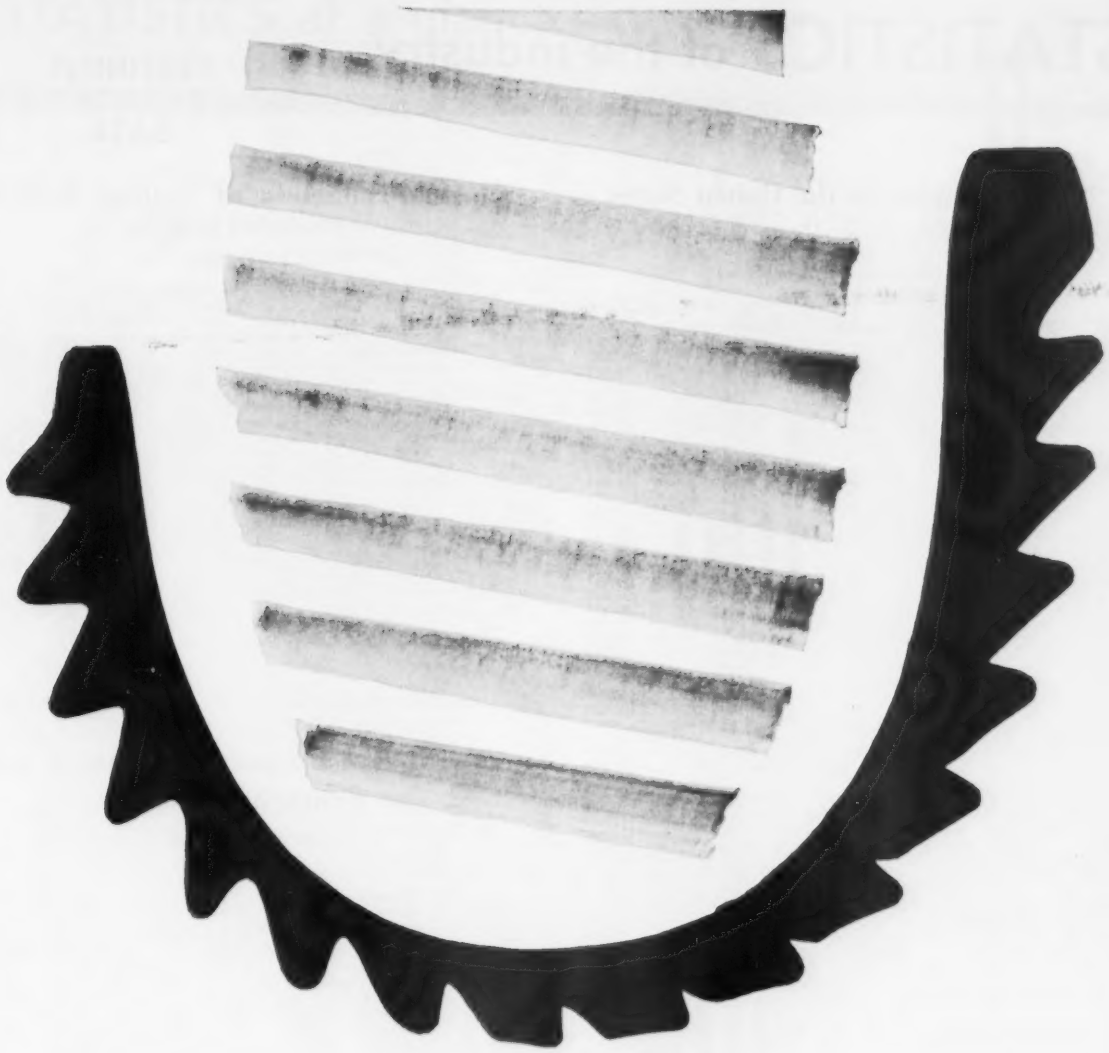
Another factor which contributes to the general rosy situation is the price stability which the synthetic latices have been exhibiting. For the short run, tight supplies of natural may force the price of that type up. This will mean a gain for synthetic latices by reason of stable price structure. In total, it can be expected that synthetic latex will increase its over-all share of the latex market in 1959.

Cotton

The price of middling uplands cotton on the New York Cotton Exchange has moved in the very narrow range of 20 points since our last report (February 2), high for the period being 35.75c reached on February 24 and 25 and low being 35.55c reached on February 19. The average price of middling uplands for the month of February was 35.69c based on 18 trading days. This comparies with an average of 35.67c in the previous month.

Rep. Frank Coffin (Dem., Maine), has denounced the new higher 8c per pound cotton export subsidy, to become effective August 1. He said congress may have to protect domestic manufacturers on this score. The new export subsidy will mean that foreign cotton mills will get United States cotton for 23.5c per pound or 34 per cent less than the 31.5c per pound American mills will have to pay.

Announcement of the new export subsidy will also encourage foreign buyers to delay purchases until after August 1, further cutting cotton exports, Mr. Coffin stated. Unless the approach to the cotton problem is modified, he warned, congress must adopt legislation to protect domestic manufacturers.



REINFORCED WITH **HI-SIL® 233,** RESILIENT ***RIPPLE® SOLE** REGISTERS RESOUNDING RECEPTION

Beebe Rubber Company of Nashua, New Hampshire, is the licensed producer of the unique and increasingly popular RIPPLE® Sole. Compound requirements are extreme; a combination of singularly good abrasion, tear, and flex life—with outstanding bounce and resilience.

The "Vees" molded into the RIPPLE® Sole must rebound from rough and rugged treatment, since only the limited area of their crowns constitutes the entire walking surface. It's a job of reinforcement tailor-made for our Columbia-Southern Hi-Sil 233, which in Beebe's judgment "just works out better in our compounds than any of the other reinforcers we'd tried."

In Canada, Kaufman Rubber (Ontario) Limited, Kitchener, Ontario, has reported equal success.

Excellent physicals in brightly colored stocks are no longer a problem, with Columbia-Southern white reinforcing pigments on the scene. If spectrum-spanning color can give *your* compounds a lift, we suggest you take a look at Hi-Sil 233, Silene® EF, or Calcene® TM, NC, or CO. Each is tops in its field . . . and *should* be in your formula book.

Columbia-Southern Chemical Corporation, One Gateway Center, Pittsburgh 22, Pa. Offices in fourteen principal cities. In Canada: Standard Chemical Limited.

RIPPLE® Soles, as displayed on these shoes by (left to right) Cardone & Baker, E. T. Wright, and Buster Brown, are available in red, chocolate, natural, grey, black and white.

*TM—RIPPLE SOLE CORP.

COLUMBIA-SOUTHERN CHEMICAL CORPORATION

A Subsidiary of Pittsburgh Plate Glass Company

STATISTICS of the industry

PERTINENT INDUSTRY DATA

Natural Rubber in the United States

(Including Latex and Guayule)

(All Quantities in Long Tons)

Year	New Supply	Consumption	Re-Exports	Stocks On Hand at End of Period
1931	501,788	355,200	25,609	322,000
1932	414,668	336,700	20,937	379,000
1933	418,902	412,400	20,576	365,000
1934	463,018	462,500	23,856	355,000
1935	467,146	495,500	11,391	303,000
1936	488,145	575,000	12,582	223,000
1937	600,479	543,600	7,902	262,204
1938	411,983	437,031	5,652	231,500
1939	499,473	592,000	13,125	125,800
1940	818,243	648,500	7,060	288,864
1941	1,029,007	775,000	5,376	533,344
1942	282,653	376,791	10,856	422,714
1943	55,329	317,634	20,815	139,594
1944	107,834	144,115	9,665	93,650
1945	135,672	105,429	6,743	118,715
1946	400,687	277,597	4,338	237,467
1947	688,354	562,661	4,101	129,038
1948	735,227	627,332	6,673	141,541
1949	660,792	574,522	6,253	106,619
1950	802,249	720,268	8,644	89,215
1951	733,048	454,015	2,603	76,569
1952	805,997	453,846	3,024	95,260
1953	647,150	553,473	8,376	112,316
1954	596,848	596,285	7,443	104,543
1955	635,174	634,800	10,611	110,105
1956	580,510	563,095	11,300	115,949
1957	499,121	539,761	10,146	100,901
1957:				
Dec.	44,544	38,058	1,000	100,473
1958:				
Jan.	45,564	42,597	706	104,979
Feb.	52,546	36,711	903	110,880
Mar.	41,986	38,191	1,150	112,863
Apr.	31,511	36,608	1,395	107,897
May	29,237	36,014	1,707	100,985
June	28,279	37,607	1,634	91,779
July	27,521	34,235	3,107	85,577
Aug.	39,057	39,444	1,369	85,666
Sept.	38,321	44,814	1,019	82,622
Oct.	40,267	48,957	2 550	77,859
Nov.	42,484	43,877	3,140	75,335
Dec.	57,067	46,600	2,000	75,325

Source: U. S. Department of Commerce.

U. S. Imports of Natural Rubber

Year	Dry: Long Tons	Dry: Declared Value	Latex: Long Tons	Latex: Declared Value	Total Imports
1936	467,064	152,072,496	19,852	6,659,899	486,916
1937	574,600	237,307,041	23,185	10,213,670	597,785
1938	397,640	125,373,864	11,944	4,168,127	409,584
1939	469,946	167,586,780	27,437	10,467,552	497,383
1940	781,202	303,308,823	33,789	14,593,466	814,991
1941	989,498	401,976,317	34,797	15,965,627	1,024,245
1942	266,276	112,537,426	10,646	5,630,667	276,922
1943	50,358	31,369,198	1,890	1,312,202	52,248
1944	103,847	73,908,549	3,091	2,092,211	106,938
1945	134,408	95,814,102	4,773	3,115,853	139,181
1946	376,502	228,796,110	8,421	5,843,085	384,923
1947	691,087	306,951,814	17,542	9,787,722	708,629
1948	702,293	290,849,177	32,745	18,288,223	735,038
1949	630,808	225,343,624	29,743	14,968,650	660,551
1950	747,109	416,222,598	54,401	41,764,486	801,510
1951	677,874	727,343,348	54,963	80,178,309	732,837
1952	756,987	578,179,519	48,228	40,563,116	805,215
1953	571,635	284,909,223	75,511	46,353,333	647,146
1954	522,364	219,098,143	74,483	42,755,029	596,847
1955	542,507	360,435,303	92,825	80,163,114	635,332
1956	499,479	334,990,045	71,709	61,795,844	564,321
1957	475,958	291,337,628	78,567	58,249,788	554,174
1958:					
Jan.	39,275	20,938,606	6,290	4,210,554	45,565
Feb.	39,005	20,299,708	7,013	4,787,054	46,018
Mar.	32,740	16,891,665	7,147	4,736,971	39,887
Apr.	28,582	14,476,348	6,348	4,148,636	34,930
May	27,941	13,520,935	4,121	2,760,020	32,062
June	23,596	11,000,264	4,323	2,741,928	27,919
July	22,665	10,305,428	3,158	2,002,980	25,823
Aug.	33,917	15,957,912	5,140	3,097,894	39,057
Sept.	36,309	16,945,200	5,034	3,247,978	41,343
Oct.	38,142	18,121,031	6,994	4,676,358	45,136

Source: Bureau of the Census, U. S. Department of Commerce.

World Production of Natural Rubber

(Including Latex)

(Long Tons)

Year	Malaya	Indonesia	Ceylon	Viet Nam & Cambodia	Latin America*	Rest of World*	Total*
1947	646,362	277,951	89,000	38,128	34,928	172,782	1,260,000
1948	698,189	432,349	95,000	43,935	29,158	225,557	1,525,000
1949	671,503	432,996	89,500	43,010	27,318	225,659	1,490,000
1950	694,090	696,472	113,500	48,482	26,902	280,299	1,860,000
1951	605,346	814,406	105,000	52,136	29,777	278,262	1,885,000
1952	584,238	750,494	96,500	63,134	35,475	261,211	1,790,000
1953	574,390	692,164	98,610	74,545	35,318	250,182	1,725,000
1954	584,435	738,670	93,935	78,024	26,833	280,112	1,802,500
1955	639,128	733,786	93,830	80,172	6,000	344,584	1,897,500
1956	568,550	686,667	95,389	89,072	22,457	336,015	1,857,000
1957	638,706	684,515	98,164	58,440	28,351	381,824	1,890,000
1958:							
May	45,398	37,779	8,516	5,324	500	32,483	130,000
June	53,105	45,731	5,646	5,526	500	34,492	145,000
July	60,376	66,099	8,263	6,090	500	33,672	175,000
Aug.	58,807	62,413	8,925	5,425	500	33,930	170,000
Sept.	57,355	57,659	8,021	8,116	500	35,849	167,500
Oct.	58,743	63,440	7,204	....	500	42,613	172,500
Nov.	51,689	63,439	9,215	....	500	42,657	167,500

Source: International Rubber Study Group. * Estimated.

World Consumption of Natural and Synthetic Rubber

(Including Latex)

(Long Tons)

Year	United States	United Kingdom	Canada	Europe*	Rest of World*	Total*
1946	1,039,296	126,770	39,196	145,000	115,804	1,467,500
1947	1,122,327	156,399	61,452	242,500	153,548	1,735,000
1948	1,069,404	196,286	62,121	392,000	182,379	1,902,500
1949	988,903	186,622	56,362	446,500	207,388	1,887,500
1950	1,258,557	222,425	68,695	448,500	287,055	2,285,000
1951	1,214,298	238,101	70,809	476,500	314,941	2,312,500
1952	1,261,413	202,179	67,099	550,000	254,901	2,335,000
1953	1,338,309	211,453	73,394	521,000	343,606	2,500,000
1954	1,233,012	247,612	71,656	544,250	408,094	2,505,000
1955	1,529,699	266,804	84,528	630,000	464,250	2,980,000
1956	1,436,482	232,345	91,458	775,500	489,215	3,025,000
1957	1,464,640	239,021	88,379	777,250	565,710	3,135,000
1958:						
May	102,318	20,165	6,836	73,750	41,931	247,500
June	107,413	22,023	7,701	85,000	52,863	275,000
July	98,100	17,410	6,816	69,750	50,424	245,000
Aug.	111,206	11,763	5,454	61,250	52,827	242,500
Sept.	123,275	22,596	8,140	78,250	70,239	302,500
Oct	136,972	19,020	8,014	.....	135,994	300,000
Nov.	122,114	19,401	....	.....	135,985	277,500

Source: International Rubber Study Group. * Estimated.

Rim Production

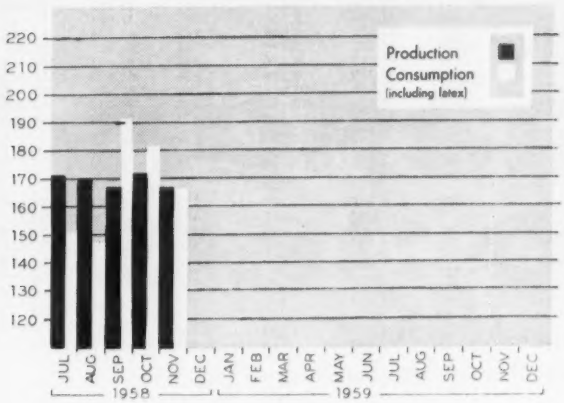
	1953	1954	1955	1956	1957
Passenger Car	31,318,461	25,952,322	38,092,080	27,109,610	27,301,567
Truck & Bus	5,228,831	4,463,689	6,642,329	6,315,428	5,468,223
Agricultural	1,943,489	1,279,040	1,931,768	1,416,938	1,368,127
Earth Mover	24,685	21,536	38,849	88,812	67,289
Total	38,514,954	31,734,587	46,705,036	34,930,788	34,205,206

	1958 Aug.	Sept.	Oct.	Nov.	Dec.	1959 Jan.
Passenger Car	999,623	1,466,800	1,921,856	2,101,264	2,779,148	2,497,831
Truck & Bus	214,813	325,764	350,833	408,232	456,754	395,926
Agricultural	61,286	61,021	100,293	87,715	212,999	91,379
Earth Mover	6,492	7,830	2,925	3,680	8,705	8,140
Total	1,282,214	1,861,415	2,375,907	2,600,891	3,457,606	2,993,276

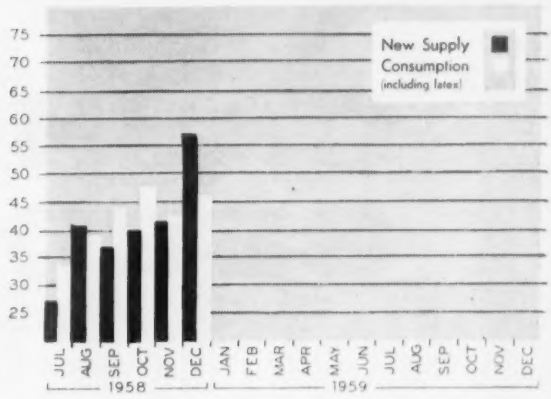
Source: The Tire & Rim Association, Inc.

STATISTICS at a glance

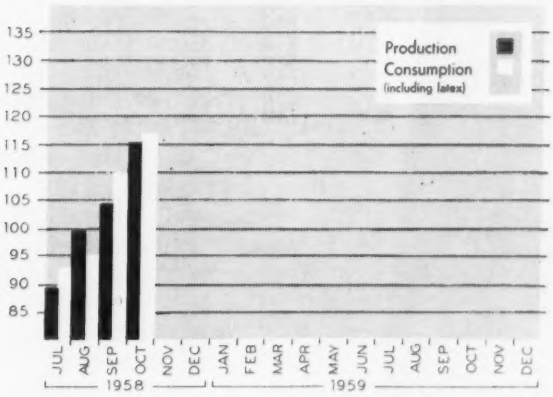
NATURAL RUBBER—WORLD
(thousands of long tons)



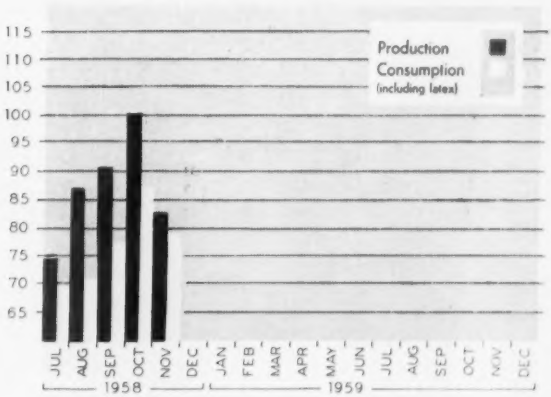
NATURAL RUBBER—UNITED STATES
(thousands of long tons)



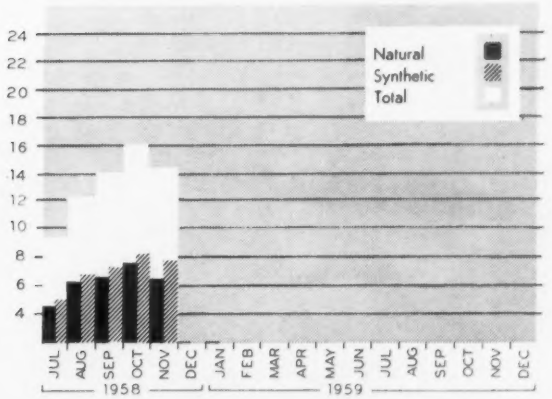
SYNTHETIC RUBBER—WORLD
(thousands of long tons)



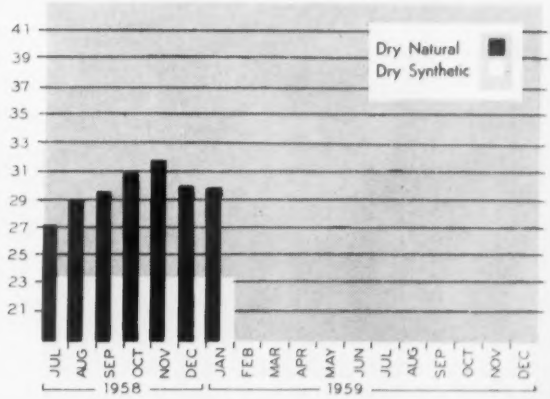
SYNTHETIC RUBBER—UNITED STATES
(thousands of long tons)



LATEX CONSUMPTION—UNITED STATES
(thousands of long tons)



PRICES—NATURAL AND SYNTHETIC
(cents per pound)



Synthetic Rubber in the United States

(All Quantities in Long Tons)

New Supply

Year	GR-S	Neoprene	Butyl	N-Type	Total
1949	310,539	35,215	54,046	11,072	410,932
1950	378,887	50,067	60,915	12,037	501,906
1951	704,529	58,907	76,475	15,333	855,244
1952	654,854	65,745	81,630	16,228	818,447
1953	680,728	80,495	79,801	20,198	861,222
1954	490,405	69,150	58,802	21,396	639,753
1955	801,145	91,357	56,179	32,623	982,304
1956	876,982	99,412	75,873	34,547	1,086,814
1957	913,321	110,721	67,418	33,618	1,125,078
1958:					
Jan.	85,828	8,804	6,189	2,419	103,240
Feb.	66,693	8,200	5,038	2,198	82,129
Mar.	69,650	7,671	4,808	2,082	84,211
Apr.	59,677	7,973	4,406	2,249	74,305
May	62,642	7,450	4,512	2,369	76,973
June	63,032	7,251	2,080	2,327	74,690
July	64,944	6,248	3,907	2,221	77,320
Aug.	73,338	6,745	4,725	2,824	87,632
Sept.	75,111	8,586	4,363	3,165	91,225
Oct.	82,741	9,283	5,338	3,619	100,981
Nov.	64,778	10,394	4,145	3,575	82,892

Consumption

1950	416,230	43,781	66,348	11,930	538,289
1951	626,444	48,887	70,500	13,066	758,897
1952	666,420	55,522	71,229	13,866	807,037
1953	624,181	65,900	77,826	16,929	784,836
1954	500,345	57,203	61,464	17,715	636,727
1955	741,997	72,876	53,991	26,035	894,899
1956	727,789	74,887	49,615	24,976	877,267
1957	767,218	75,461	55,413	25,187	923,279
1958:					
Jan.	60,179	5,928	4,508	2,010	72,625
Feb.	52,962	5,045	4,255	1,968	64,230
Mar.	54,816	4,965	4,297	1,962	66,040
Apr.	55,133	4,962	4,621	1,897	66,613
May	55,463	4,805	4,258	1,778	66,304
June	58,507	4,844	4,402	2,053	69,806
July	53,903	4,454	3,791	1,717	63,865
Aug.	59,458	5,719	4,277	2,308	71,762
Sept.	64,860	6,405	4,725	2,471	78,461
Oct.	73,242	7,105	4,982	2,686	88,015
Nov.	65,883	6,211	4,419	2,500	79,013

Exports

1950	900	4,826	31	1,895	7,652
1951	483	6,825	216	1,725	9,249
1952	9,467	9,813	126	2,695	22,101
1953	7,692	11,494	237	3,245	22,668
1954	11,069	12,062	2,831	4,155	30,117
1955	60,704	18,098	9,895	4,593	93,290
1956	112,366	21,909	8,699	6,194	149,168
1957	157,977	30,242	8,748	6,377	203,344
1957:					
1958:					
Jan.	14,109	2,649	1,626	513	18,897
Feb.	9,947	2,626	1,415	378	14,366
Mar.	15,647	3,424	757	410	20,238
Apr.	11,583	2,356	949	698	15,586
May	14,067	2,899	1,218	784	18,968
June	11,993	1,562	1,022	473	15,050
July	10,602	2,403	1,051	674	14,730
Aug.	8,521	2,603	972	558	12,654
Sept.	8,802	2,774	812	518	12,906
Oct.	11,557	2,547	1,407	553	16,064

Stocks

1949	77,731	4,654	12,224	3,433	98,042
1950	36,942	5,733	7,243	2,840	52,758
1951	105,271	8,379	12,481	3,821	129,912
1952	83,861	8,535	22,716	3,875	118,987
1953	135,153	11,480	24,866	4,346	175,845
1954	115,499	11,349	19,267	4,280	150,395
1955	108,989	12,220	10,500	6,030	137,739
1956	151,763	14,077	28,744	7,934	202,518
1957	140,199	18,843	31,489	7,454	197,985
1958:					
Feb.	151,501	18,409	31,369	7,635	208,914
Mar.	153,221	18,504	30,796	6,947	209,468
Apr.	143,981	18,764	30,012	6,469	199,226
May	137,277	19,014	29,246	6,392	191,929
June	132,800	18,763	25,954	6,231	183,721
July	132,303	18,242	24,882	6,097	181,524
Aug.	136,735	16,344	24,618	6,224	183,921
Sept.	138,987	15,154	22,554	6,145	182,840
Oct.	134,613	15,474	22,091	6,356	178,534
Nov.	140,673	15,373	20,192	7,273	183,511

Source: U. S. Department of Commerce.

Natural and Synthetic Rubber Latex in the United States

(All Quantities in Long Tons)

New Supply

Year	Natural	GR-S	Neoprene	N-Type	Total Synthetic	Grand Total
1945	4,768	15,176	7,077	.....	22,253	27,021
1946	8,012	24,810	13,595	.....	38,405	46,417
1947	17,675	22,474	6,089	.....	28,563	46,238
1948	32,630	21,494	5,022	.....	26,516	59,146
1949	29,974	21,357	3,651	.....	25,008	54,982
1950	54,401	31,339	5,725	.....	37,064	91,465
1951	54,963	32,972	6,866	2,948	42,786	97,749
1952	48,228	42,273	7,598	4,164	54,035	102,263
1953	75,511	48,112	9,026	5,844	62,982	138,493
1954	74,483	48,379	8,214	6,866	63,459	137,942
1955	92,754	69,364	10,432	10,798	90,594	183,348
1956	72,013	69,720	10,642	10,650	91,012	163,025
1957	72,252	74,535	10,403	11,420	96,358	168,610
1957:						
Dec.	7,572	5,915	704	734	7,353	14,925
1958:						
Jan.	6,289	5,998	788	785	7,571	13,860
Feb.	7,013	3,852	765	671	5,288	12,301
Mar.	7,147	4,880	759	787	6,426	13,573
Apr.	6,348	3,889	907	830	5,626	11,974
May	4,121	3,635	808	882	5,325	9,446
June	4,323	4,539	696	890	6,125	10,448
July	3,158	3,645	677	893	5,215	8,373
Aug.	5,140	5,474	892	1,103	7,469	12,609
Sept.	4,810	6,165	1,075	1,173	8,413	13,223
Oct.	5,878	7,617	1,170	1,308	10,095	15,973
Nov.	4,628	7,307	1,156	1,205	9,668	14,296

Consumption[1]

1945	3,886	14,500	6,800	....	21,300	25,186
1946	5,714	23,500	13,000	....	36,500	42,214
1947	13,909	22,500	6,500	....	29,000	42,909
1948	28,489	21,500	5,250	....	26,750	55,239
1949	36,117	21,500	3,750	....	25,250	61,367
1950	56,138	31,000	5,500	....	36,500	92,638
1951	46,750	31,031	6,279	2,628	39,938	86,688
1952	53,567	40,562	7,368	3,093	51,023	104,590
1953	67,375	46,473	7,981	3,654	58,108	125,483
1954	75,931	44,173	7,251	4,507	55,931	131,862
1955	86,478	63,982	8,736	8,495	81,213	167,691
1956	74,082	62,762	8,708	8,021	79,491	153,573
1957	75,009	68,305	9,039	8,630	85,974	160,983
1957:						
Dec.	5,816	5,338	651	606	6,595	12,411
1958:						
Jan.	6,380	5,438	806	683	6,927	13,307
Feb.	5,380	4,475	640	806	5,921	11,301
Mar.	5,560	4,708	633	720	6,061	11,621
Apr.	4,847	4,093	707	797	5,597	10,444
May	5,004	4,102	785	795	5,682	10,686
June	5,304	4,165	639	919	5,723	11,027
July	4,531	3,433	629	703	4,765	9,296
Aug.	6,094	4,654	764	1,025	6,443	12,537
Sept.	6,748	5,779	820	1,017	7,616	14,364
Oct.	7,725	6,534	979	1,120	8,633	16,358
Nov.	6,540	6,009	798	1,108	7,915	14,455

Stocks at End of Period

1945	3,121	....	....	....	....	3,121
1946	4,865	....	....	....	....	4,865
1947	5,033	....	....	....	....	5,033
1948	11,235	....	....	....	....	11,235
1949	5,063	....	....	....	....	5,063
1950	4,927	....	....	....	....	4,927
1951	4,752	3,727	1,245	532	5,504	10,256
1952	6,201	5,040	1,019	902	6,961	13,162
1953	13,532	4,794	1,117	721	6,632	20,164
1954	11,133	5,134	1,087	811	7,032	18,165
1955	13,203	6,980	1,236	1,807	10,203	23,406
1956	12,064	7,451	1,384	1,558	10,393	22,457
1957	14,454	8,347	1,267	1,974	11,588	26,042
1957:						
Dec.	14,454	8,662	1,267	1,974	11,903	26,357
1958:						
Jan.	14,178	8,222	1,190	2,052	11,464	25,642
Feb.	15,506	7,992	1,251	2,297	11,540	27,046
Mar.	16,825	7,991	1,281	1,974	11,246	28,071
Apr.	17,415	7,756	1,398	1,744	10,898	28,313
May	17,604	7,240	1,292	1,732	10,264	27,868
June	17,078	7,337	1,267	1,888	10,492	27,570
July	15,516	6,693	1,312	1,990	9,995	25,511
Aug.	13,750	7,166	1,195	2,049	10,410	24,160
Sept.	12,482	6,842	1,354	2,096	10,616	23,098
Oct.	10,324	7,129	1,365	2,229	10,376	20,700
Nov.	8,795	7,810	1,498	2,530	11,838	20,633

Source: U. S. Department of Commerce.
Note: (1) GR-S and Neoprene consumption estimated through 1950.

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1. Controlled for Chemical Purity
HORSE HEAD zinc oxides are made only from prime raw materials—selected zinc ores from our own mines and high-purity slab zinc from our own refineries.

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HORSE HEAD zinc oxides are made in special furnaces of our own design that enable close control of particle size.

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Avoid masterbatching, maintain maximum Banbury output with the PROTOX brands . . . zinc propionate-coated for outstanding dispersion.

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SEATTLE PORTLAND (ORE.) SPOKANE VANCOUVER, B. C. DALLAS HOUSTON

ST. LAWRENCE CHEMICAL COMPANY, LTD.

TORONTO, ONT. MONTREAL, QUE.

Automotive Pneumatic Casings

(Thousands of Units)

	Shipments					
	Original Equipment	Replacement	Export	Total	Production	Inventory End of Period
1951 (total)	32,153	44,612	1,677	78,442	83,405	8,765
Passenger Car.	26,729	34,226	723	61,678	65,546	6,973
Truck and Bus	5,424	10,386	954	16,764	17,859	1,791
1952 (total)	29,484	54,342	1,520	85,346	90,411	14,110
Passenger Car.	24,106	45,458	741	70,305	74,341	11,251
Truck and Bus	5,378	8,884	779	15,041	16,070	2,859
1953 (total)	37,949	55,124	1,543	94,617	96,150	15,720
Passenger Car.	33,106	45,798	809	79,713	81,455	13,044
Truck and Bus	4,843	9,326	734	14,904	14,696	2,676
1954 (total)	33,333	55,155	1,753	90,241	89,141	14,762
Passenger Car.	29,741	47,044	928	77,713	76,794	12,217
Truck and Bus	3,591	8,111	826	12,528	12,347	2,545
1955 (total)	47,374	59,246	1,879	108,499	112,178	18,778
Passenger Car.	42,574	50,189	966	93,730	97,223	15,963
Truck and Bus	4,800	9,057	912	14,769	14,955	2,815
1956 (total)	35,422	62,146	1,757	99,325	100,406	79,872
Passenger Car.	30,873	53,252	875	85,000	85,546	16,494
Truck and Bus	4,548	8,894	883	14,325	14,859	3,378
1957 (total) ...	36,765	65,150	1,733	103,649	106,940	250,536
Passenger Car.	32,725	56,603	889	90,217	93,542	210,146
Truck and Bus	4,053	8,546	846	13,432	13,398	40,384
1958 (total)	26,783	70,797	1,348	98,928	96,563	20,939
Passenger Car.	23,408	61,570	717	85,696	83,636	17,778
Truck and Bus	3,375	9,226	631	13,232	12,927	3,161
1958:						
Jan. (total)	2,653	5,511	107	8,271	7,814	22,769
Passenger Car.	2,377	4,838	50	7,264	6,740	19,299
Truck and Bus	277	674	57	1,007	1,074	3,470
Feb. (total)	2,253	4,374	110	6,737	7,314	23,392
Passenger Car.	1,998	3,777	57	5,833	6,320	19,820
Truck and Bus	254	598	52	904	994	3,572
Mar. (total)	2,114	5,334	95	7,543	7,573	23,446
Passenger Car.	1,845	4,726	49	6,621	6,569	19,786
Truck and Bus	269	608	46	923	1,004	3,659
Apr. (total)	1,876	6,183	116	8,175	7,477	22,658
Passenger Car.	1,594	5,517	61	7,173	6,522	19,051
Truck and Bus	282	666	55	1,002	955	3,607
May (total)	2,173	6,220	110	8,503	7,653	21,834
Passenger Car.	1,874	5,593	56	7,523	6,715	18,263
Truck and Bus	299	626	54	980	938	3,571
June (total)	1,932	7,182	117	9,231	8,293	20,920
Passenger Car.	1,667	6,387	63	8,117	7,306	17,465
Truck and Bus	265	794	54	1,113	988	3,456
July (total)	2,020	7,442	111	9,573	7,288	18,615
Passenger Car.	1,756	6,502	60	8,318	6,368	15,501
Truck and Bus	265	940	51	1,255	920	3,114
Aug. (total)	1,055	6,679	115	7,848	7,762	18,521
Passenger Car.	847	5,807	57	6,711	6,753	15,535
Truck and Bus	208	871	57	1,137	1,009	2,986
Sept. (total)	1,442	6,365	105	7,912	8,277	18,925
Passenger Car.	1,170	5,425	64	6,659	7,134	16,045
Truck and Bus	271	940	41	1,253	1,143	2,880
Oct. (total)	1,838	6,476	140	8,454	9,344	19,913
Passenger Car.	1,522	5,369	81	6,972	7,983	17,134
Truck and Bus	316	1,106	59	1,482	1,361	2,779
Nov. (total) ...	3,369	4,320	100	7,788	8,393	20,403
Passenger Car.	3,056	3,651	58	6,765	7,182	17,420
Truck and Bus	313	669	42	1,023	1,211	2,983
Dec. (total) ...	4,057	4,711	124	8,892	9,376	20,939
Passenger Car.	3,701	3,977	61	7,739	8,046	17,778
Truck and Bus	356	734	63	1,153	1,330	3,161

Source: The Rubber Manufacturers Association, Inc.

Automobile Production in U. S.

(Civilian Production Only)

Year	Passenger Cars	Trucks	Total	Year	Passenger Cars	Trucks	Total
1939	2,866,796	704,308	3,571,104	1949	5,108,841	1,123,736	6,232,577
1940	3,692,328	721,637	4,413,965	1950	6,665,836	1,332,263	7,998,099
1941	3,744,500	875,381	4,619,681	1951	5,337,729	1,420,432	6,758,161
1942	220,814	133,083	353,897	1952	4,320,794	1,212,790	5,533,584
1943	0	4,501	4,501	1953	6,121,787	1,202,196	7,323,983
1944	0	124,819	124,819	1954	5,558,897	1,038,045	6,596,942
1945	83,792	313,643	397,435	1955	7,920,186	1,245,018	9,165,204
1946	2,148,699	930,760	3,079,429	1956	5,816,109	1,100,417	6,916,526
1947	3,558,178	1,220,634	4,778,812	1957	6,113,344	1,097,006	7,210,350
1948	3,909,270	1,363,856	5,132,090	1058	4,257,812	874,278	5,132,090
1957:							
Jan.	628,045	91,117	719,162	July	484,718	96,048	580,766
Feb.	570,023	91,767	661,790	Aug.	521,282	90,152	611,434
Mar.	585,734	91,703	676,437	Sept.	318,279	63,131	381,410
Apr.	541,733	105,175	646,908	Oct.	291,064	88,879	379,943
May	537,112	102,312	639,424	Nov.	583,783	94,574	678,357
June	496,329	94,321	590,650	Dec.	555,242	87,327	642,569
1958:							
Jan.	478,416	79,790	558,206	July	316,408	65,047	381,455
Feb.	396,221	71,024	467,245	Aug.	194,974	55,221	250,195
Mar.	359,464	73,658	433,122	Sept.	102,687	46,353	149,040
Apr.	322,482	73,886	396,368	Oct.	272,241	69,934	342,175
May	352,076	75,291	427,367	Nov.	511,885	93,282	605,167
June	342,228	70,652	412,880	Dec.	608,730	100,140	708,870

Source: Automobile Manufacturers Association.
Note: Figures are based on factory sales. Revisions are made from time to time in these figures and the latest issue should be consulted for accuracy.

Automotive Inner Tubes

(Thousands of Units)

	Shipments					
Year	Original Equipment	Replacement	Export	Total	Production	Inventory End of Period
1946	15,327	59,357	1,424	76,108	77,251	3,820
1947	25,046	46,560	2,483	74,088	79,181	8,059
1948	26,833	40,548	1,119	68,499	70,033	9,641
1949	31,521	31,450	887	63,858	65,114	10,657
1950	41,240	42,671	811	84,723	80,179	....
1951	32,151	32,284	1,071	65,507	67,249	10,094
1952	29,451	32,985	1,014	63,449	65,073	12,036
1953	37,957	36,072	878	74,907	74,425	11,874
1954	25,071	35,576	945	61,593	48,279	9,519
1955	5,001	33,387	1,001	39,389	35,900	6,833
1956	3,100	32,358	1,040	36,498	34,405	6,109
1957	3,046	35,687	1,076	39,806	39,774	80,077
1958	2,678	37,872	870	41,420	41,266	8,602
1958:						
Jan.	232	4,005	72	4,309	3,344	6,700
Feb.	209	3,014	73	3,412	3,444	6,866
Mar.	209	3,481	74	3,764	3,685	7,066
Apr.	201	2,978	64	3,243	3,624	7,609
May	225	2,742	68	3,035	3,530	8,189
June	202	3,332	67	3,602	3,476	8,156
July	215	3,174	76	3,466	2,890	7,680
Aug.	160	3,097	74	3,331	3,305	7,664
Sept.	207	3,228	63	3,498	3,390	7,657
Oct.	244	3,238	84	3,567	3,768	7,869
Nov.	264	2,575	60	2,899	3,319	8,372
Dec.	288	3,029	94	3,411	3,491	8,602

Source: The Rubber Manufacturers Association, Inc.

Vinyl and Vinyl Copolymer Resins—Sales

(Thousands of Pounds—Resin Content)

	Polyvinyl Chloride and Copolymer Resins							All Other Vinyl Resins		
	Film	Sheeting	Molding & Extrusion	Textile & Paper Treating	Flooring	Protective Coatings	All Other Uses	Adhesives	All Other Uses	Grand Total
1953	63,691	62,385	129,215	52,353	22,152	22,823	27,790	22,411	77,478	480,299
1954	69,943	56,588	147,284	49,546	34,890	23,676	35,148	26,609	74,090	517,773
1955	83,276	51,424	183,736	64,223	56,357	27,439	53,868	31,853	105,644	657,821
1956	78,063	55,598	206,726	62,931	65,384	28,522	71,859	36,565	115,151	720,799
1957	90,543	56,344	216,517	66,392	81,357	31,519	50.637	41,665	113,396	748,370
1958	72,404	67,594	214,701	63,050	113,583	28,913	68,307	52,904	117,752	801,208
1957:										
1958:										
Jan.	5,870	4,119	16,361	4,035	7,562	2,885	4,071	3,213	10,780	58,896
Feb.	5,902	4,412	13,907	4,468	7,964	2,250	3,369	3,484	9,193	54,949
Mar.	6,530	4,248	15,340	3,863	9,215	2,322	3,760	3,941	9,036	58,255
Apr.	5,424	4,643	15,705	3,881	9,079	2,056	5,287	4,087	9,696	59,858
May	5,534	5,331	15,958	4,769	10,347	2,518	5,519	3,675	9,149	64,800
June	5,986	5,716	16,205	5,462	9,117	2,518	4,020	3,932	9,399	62,355
July	4,796	5,330	15,520	4,883	8,093	2,526	3,860	4,381	4,362	53,751
Aug.	6,594	5,547	19,286	6,245	10,530	2,810	6,002	9,194	9,497	75,705
Sept.	6,696	6,971	20,029	6,194	10,340	2,370	7,236	4,308	11,349	75,493
Oct.	7,358	6,975	23,989	7,116	11,555	2,528	8,580	4,859	13,560	86,520
Nov.	5,760	6,431	20,239	6,024	9,938	2,134	7,227	4,015	10,439	72,207
Dec.	5,954	7,871	22,162	6,110	9,843	1,996	9,376	3,815	11,292	78,419

Source: Chemical Division, U. S. Tariff Commission.

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NO "DOWN-TIME"
in Continuous Roll Stock Processing!

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Paper • Plastic Films • Foils and all other Web Materials

Stanford FLYING-SPLICE

TURRET-TYPE UNWIND & REWIND STANDS

Instantaneously splices on second roll WITHOUT STOPPING PROCESS

Model TO-24
Turret-Type
UNWIND STAND
Unique dual-roll "Flying Splice" instantly attaches new roll to moving web without stopping.

Model TO-24R
Turret-Type
REWIND STAND
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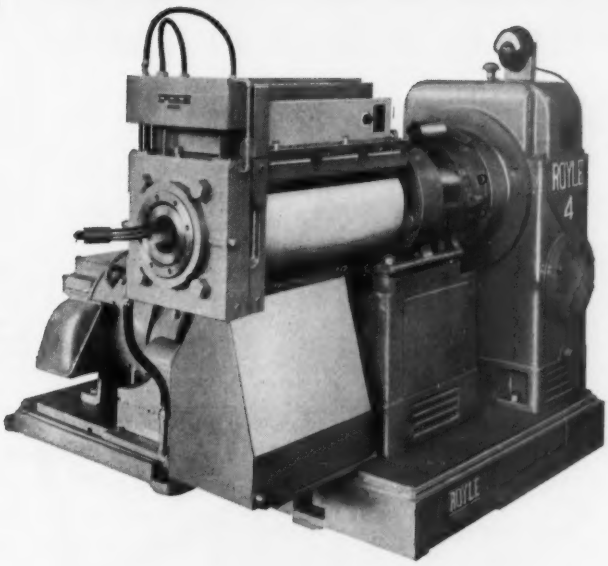

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Send for Bulletin Number 463

JOHN ROYLE & SONS

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Rubber Industry Employment Earnings and Hours

All Rubber Products

Mo.	1957 Production Workers (thousands)	1957 Average Weekly Earnings	1957 Average Weekly Hours	1957 Average Hourly Earnings	1958 Production Workers (thousands)	1958 Average Weekly Earnings	1958 Average Weekly Hours	1958 Average Hourly Earnings
Jan.	216.0	$91.21	40.9	$2.23	200.9	$87.48	38.2	$2.29
Feb.	212.6	90.80	40.9	2.22	191.3	85.04	37.3	2.28
Mar.	211.4	89.28	40.4	2.21	184.0	87.02	38.0	2.29
Apr.	191.3	87.60	40.0	2.19	176.0	85.88	37.5	2.29
May	204.2	88.80	40.0	2.22	172.3	87.86	38.2	2.30
June	196.8	91.21	40.9	2.23	175.8	91.10	39.1	2.33
July	199.8	94.16	41.3	2.28	175.1	91.89	39.1	2.35
Aug.	204.3	92.84	40.9	2.27	181.2	96.08	40.5	2.39
Sept.	206.4	92.97	40.6	2.29	188.0	96.87	40.7	2.38
Oct.	209.5	93.03	40.1	2.32	192.1	....	...	...
Nov.	209.0	93.20	40.0	2.33	....	....	...	...
Dec.	207.3	92.40	40.0	2.31	....	....	...	...

Tires and Tubes

Jan.	87.4	107.64	41.4	2.60	81.6	98.52	36.9	2.67
Feb.	86.8	106.19	41.0	2.59	78.5	93.02	35.1	2.65
Mar.	86.9	102.40	40.0	2.56	76.0	98.05	37.0	2.65
Apr.	71.1	103.46	40.1	2.58	72.1	95.67	36.1	2.65
May	84.9	103.46	40.1	2.58	70.4	99.48	37.4	2.66
June	78.2	107.23	41.4	2.59	71.2	103.63	38.1	2.72
July	83.9	112.20	42.5	2.64	71.0	106.59	38.9	2.74
Aug.	84.2	107.83	41.0	2.63	72.5	113.96	40.7	2.80
Sept.	84.4	107.20	40.3	2.66	74.6	112.16	40.2	2.79
Oct.	84.4	105.18	39.1	2.69	....	....	...	...
Nov.	84.0	106.62	39.2	2.72	....	....	...	...
Dec.	83.6	105.84	39.2	2.70	....	....	...	...

Rubber Footwear

Jan.	18.3	71.76	39.0	1.84	17.5	74.87	39.2	1.91
Feb.	17.8	72.10	39.4	1.83	17.0	74.68	39.1	1.91
Mar.	17.8	72.68	39.5	1.84	16.7	76.61	39.9	1.92
Apr.	17.5	70.64	38.6	1.83	16.5	75.46	39.3	1.92
May	17.3	71.92	39.3	1.83	16.3	75.85	39.3	1.93
June	17.4	72.29	39.5	1.83	16.3	77.20	40.0	1.93
July	16.8	72.13	39.2	1.84	15.9	75.25	39.4	1.91
Aug.	17.2	73.05	39.7	1.84	16.4	77.18	40.2	1.92
Sept.	17.6	74.45	39.6	1.88	16.8	76.82	39.6	1.94
Oct.	17.7	76.02	39.8	1.91	....	....	...	...
Nov.	18.0	78.96	40.7	1.94	....	....	...	...
Dec.	17.9	79.35	40.9	1.94	....	....	...	...

All Other Rubber Products

Jan.	110.3	81.39	40.9	1.99	101.8	80.94	39.1	2.07
Feb.	108.0	81.18	41.0	1.98	95.8	80.32	38.8	2.07
Mar.	106.7	81.19	40.8	1.99	91.3	79.87	38.4	2.08
Apr.	102.7	79.60	40.2	1.98	87.4	79.87	38.4	2.08
May	102.0	79.80	40.1	1.99	85.6	80.29	38.6	2.08
June	101.2	81.81	40.7	2.01	88.3	83.77	39.7	2.11
July	99.1	82.62	40.7	2.03	88.2	82.92	39.3	2.11
Aug.	102.9	83.84	41.1	2.04	92.3	86.24	40.3	2.14
Sept.	104.4	85.08	41.1	2.07	96.6	88.38	41.3	2.14
Oct.	107.4	86.10	41.0	2.10	....	....	...	...
Nov.	107.0	85.05	40.5	2.10	....	....	...	...
Dec.	105.8	84.03	40.4	2.08	....	....	...	...

Source: U. S. Department of Labor.

Note: Data are based upon reports from cooperating establishments covering both full and part-time employees who work during, or received pay for, any part of the pay period ending nearest the 15th of the month. These employment series have been adjusted to first quarter 1954 benchmark levels indicated by data from government social insurance programs. Hours and earnings data pertain only to production and related workers.

Spot Closing Cotton Prices

(Middling Upland Grade—New York Market—in Cents)

Average Monthly Price Per Pound

	1952	1953	1954	1955	1956	1957	1958	1959
Jan.	42.96	33.24	34.16	35.07	35.24	34.82	36.31	35.67
Feb.	41.64	33.76	35.00	35.04	36.26	34.82	35.83	35.69
Mar.	41.70	34.10	35.23	34.33	36.70	35.35	36.05	....
Apr.	41.79	33.85	35.22	34.23	36.43	35.43	36.00	....
May	39.98	34.30	35.34	34.80	36.65	35.40	36.27	....
June	41.31	34.11	35.17	34.83	36.67	35.45	36.33	....
July	40.37	34.20	35.37	34.61	35.43	35.49	36.51	....
Aug.	40.42	33.82	35.19	34.53	34.31	35.15	36.36	....
Sept.	39.75	33.69	35.46	33.85	34.35	34.74	36.00	....
Oct.	37.52	33.53	35.24	33.93	34.45	35.09	36.23	....
Nov.	35.59	33.60	34.80	34.87	34.56	36.06	36.24	....
Dec.	33.76	33.52	35.03	34.95	34.56	36.50	35.75	....
Average for Year	39.71	33.81	35.10	34.59	35.50	35.36	36.16	....

Note: The Government established a ceiling of 45.76c for spot cotton on March 3, 1951. (a) Trading suspended during February.

Production Index for the Rubber Industry

(1947-1949 = 100)

(Based on man-hours)

	1956	1957	1958		1956	1957	1958
Jan.	147	145	116	July	125	136	125
Feb.	140	141	114	Aug.	135	141	132
Mar.	135	145	116	Sept.	132	138	136
Apr.	136	132	112	Oct.	134	135	133
May	127	134	113	Nov.	126	131	141
June	120	135	125	Dec.	137	117	140

Sales by the Rubber Industry

(in Millions of Dollars*)

	1956	1957	1958		1956	1957	1958
Jan.	415	496	448	July	459	514	478
Feb.	445	495	413	Aug.	436	514	438
Mar.	451	476	396	Sept.	429	481	464
Apr.	445	490	429	Oct.	454	490	493
May	464	481	428	Nov.	463	431	...
June	450	458	445	Dec.	461	427	...

Rubber Manufacturers' Inventories

(in Millions of Dollars*)

	1956	1957	1958		1956	1957	1958
Jan.	935	1,047	1,100	July	987	1,045	980
Feb.	970	1,036	1,087	Aug.	1,007	1,074	1,024
Mar.	979	1,030	1,069	Sept.	1,007	1,074	1,024
Apr.	970	1,031	1,047	Oct.	1,002	1,097	1,022
May	985	1,024	1,020	Nov.	1,024	1,101	...
June	975	1,027	986	Dec.	998	1,092	...

Source: U. S. Department of Commerce.
Notes: * Adjusted for seasonal variation.

No. 1 R.S.S.—Annual Average Prices

(New York Market—Cents per Pound)

Year	High	Low	Avg.	Year	High	Low	Avg.
1917	90	52	72.23	1938	17⅞	10¼	14.64
1918	70	40	60.15	1939	24	14⅛	17.57
1919	57	38½	48.70	1940	24	18¼	20.10
1920	56½	16	36.30	1941	24⅞	19⅝	22.40
1921	21¼	11½	16.36	1942	22½	22½	22.50
1922	28⅜	13⅝	17.50	1943	22½	22½	22.50
1923	37⅛	24¾	29.45	1944	22½	22½	22.50
1924	40⅛	17⅝	26.20	1945	22½	22½	22.50
1925	121	34⅜	72.46	1946	22½	22½	22.50
1926	88½	36¾	48.50	1947	25	14	20.00
1927	41¾	33	37.72	1948	25	18	21.99
1928	41¼	17	22.48	1949	19¾	15⅞	17.57
1929	26⅞	15½	20.55	1950	86	18	41.10
1930	16½	7½	11.98	1951	76	52	(a)
1931	8⅝	4¼	6.17	1952*	33	26½	29.15
1932	4¼	2½	3.49	1953	31⅞	19⅞	24.21
1933	9⅞	2⅞	5.96	1954	34½	19½	23.61
1934	15⅞	8¾	12.92	1955	52	29⅜	39.16
1935	13¾	10½	12.37	1956	45	26½	34.24
1936	23	13½	16.41	1957	37⅜	26⅝	31.13
1937	26⅞	14	19.39	1958	32⅝	24⅝	28.13

Note: Price was fixed by Government on August 6, 1941, at 22½c a pound for non-war uses. Free trading was resumed May 1, 1947. (a) Free trading suspended March 31, 1951. GSA selling price ranged between 52 and 66c during balance of year. * Free trading was resumed on July 1, 1952; figures represent only July through December, 1952.

No. 1 R.S.S.—Monthly Average Prices

(New York Market—Cents per pound)

	1952	1953	1954	1955	1956	1957	1958	1959
Jan.	....	29.40	20.22	33.92	41.70	33.32	27.15	30.34
Feb.	....	27.57	19.98	34.90	33.68	30.43	26.32	30.26
Mar.	....	26.59	20.16	31.08	33.68	31.76	26.65	....
Apr.	....	24.66	22.06	31.75	31.74	32.23	26.44	....
May	....	25.52	21.96	31.35	29.61	32.12	25.51	....
June	....	24.42	23.01	34.74	30.54	32.80	26.20	....
July	30.52	23.64	24.12	40.84	33.91	32.88	27.70	....
Aug.	29.36	23.36	23.26	45.85	35.69	32.13	28.72	....
Sept.	27.42	23.06	23.99	48.27	32.64	29.94	29.49	....
Oct.	27.26	20.82	26.57	43.81	32.68	29.24	31.06	....
Nov.	29.25	20.58	28.07	44.95	35.18	27.47	32.10	....
Dec.	31.26	20.92	29.88	48.40	37.01	29.25	30.28	....
Average for Year	29.15	24.21	23.61	39.16	34.24	31.13	28.13	....

Note: (a) Free trading suspended March 31, 1951, and resumed on July 1, 1952.

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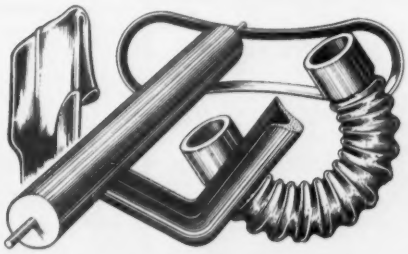

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Various Compounding Materials Consumed by the Rubber Industry

Material	1950	1951	1952	1953	1954	1955	1956
Antimony, Primary:							
Short tons	103[c]	19[c]	66[c]	20[c]	49[c]	78	56
% of total	.007	.001	.004	.001	.004	006	.013
Asphalt:[a]							
Short tons	26,819	21,414	33,288	.....	.....	.....	.....
% of total	0.3	0.3	0.4	.....	.....	.....	.. ..
Barite (Barytes):							
Short tons	19,000	15,000	18,000	21,000	20,000	25,104	22,101
% of total	3.31	2.13	2.0	2 0	2.0	2.0	2.0
Carbon Black:							
Short tons	515,184	530,614	537,273	566,797	511,813	643,430	622,325
% of total	92.9	93.9	93.1	94.4	93.5	93.5	95.5
Clay, Kaolin:							
Short tons	263,306	231,331	240,982	241,052	247,431	257,223	268,157
% of total	15.0	12.7	13.2	12.8	13.2	11.9	12.0
Clay, Fire & Stoneware:							
Short tons	9,500	.....	9,322	18,475	8,781	2,928	.....
% of total	0.1	.....	0.1	.2	.1	.2	.....
Lime:							
Short tons	908	1,126	2,000	1,631	1,555	1,465	2,487
% of total	.0002	(d)	(d)	(d)	(d)	(d)	(d)
Litharge:							
Short tons	3,047	2,641	2,109	2,230	1,768	1,947	2,266
% of total	1.7	1.1	1.5	1.4	1.3	1.3	1.7
Lithopone:							
Short tons	4,092	3,295	1,523	1,723	1,701	2,163	2,000*
% of total	3.9	3.2	2.5	3.3	3.9	5.0	5.0
Mica, Ground:							
Short tons	5,776	6,551	5,126	5,668	5,021	7,339	7,021
% of total	8.0	9.0	7.0	7.8	6.3	6.9	8.0
Sulfur:							
Short tons	75,000	84,000	84,000	89,600	84,000	89,600	89,600
% of total	1.3	1.4	1.4	1.4	1.3	1.2	1.1
Talc:[b]							
Short tons	75,900	70,970	64,476	61,408	58,139	38,309	30,253
% of total	12.0	11.2	10.9	10.0	9.7	5.4	5.0
Zinc Oxide:							
Short tons	82,944	71,507	72,774	78,439	71,058	86,677	90,000*
% of total	51.6	48.4	51.2	52.7	50.7	51.5	52.0

Source: U. S. Bureau of Mines.
Notes: (a) Solid and semi-solid products of less than 200 penetration. (b) Includes prophyllite and ground soapstone. (c) Does not include precipitated antimony sulfide as in previous years. (d) Negligible. (e) Estimated.

Reclaimed Rubber

(Including Natural and Synthetic)

(All Quantities in Long Tons)

Year	New Supply	Consumption		Exports	Stocks On Hand at End of Period
		Tons	% to Crude[a]		
1941	274,202	251,231	32.2	13,851	41,750
1942	286,007[b]	254,820	64.6	30,405	42,532
1943	304,058[c]	291,082	59.6	15,678	46,201
1944	260,631[d]	251,083	35.3	11,800	43,832
1945	243,309	241,036	30.2	13,413	28,155
1946	295,612	275,410	26.5	14,461	33,666
1947	291,395	288,395	24.8	14,556	35,943
1948	266,861	261,113	24.4	11,428	32,630
1949	224,029	226,679	22.5	10,637	28,263
1950	314,008	303,733	24.1	11,740	35,708
1951	366,700	346,121	26.6	14,722	45,082
1952	274,981	280,002	22.2	11,180	30,664
1953	298,336	285,050	21.3	11,597	32,319
1954	258,101	249,049	20.2	10,232	30,746
1955	326,649	312,781	20.4	13,988	31,498
1956	287,220	270,547	18.8	13,832	34,969
1957	271,647	267,352	18.2	13,021	29,323
1957:					
Aug.	20,432	22,429	18.1	917	28,521
Sept.	19,892	21,704	17.9	714	25,983
Oct.	26,419	24,925	18.1	1,230	27,171
Nov.	22,083	20,583	17.3	1,150	27,855
Dec.	20,101	18,263	17.2	843	29,323
1958:					
Jan.	21,958	21,186	18.4	892	29,569
Feb.	19,017	18,130	18.0	665	28,838
Mar.	20,225	19,300	18.5	1,012	28,984
Apr.	20,735	19,746	19.1	832	29,440
May	19,601	20,104	19.6	1,012	27,862
June	21,230	20,652	19.2	1,024	27,763
July	18,122	18,350	18.2	1,087	26,442
Aug.	22,432	19,347	17.4	900	27,961
Sept.	22,596	21,771	17.7	1,005	26,676
Oct.	26,523	23,563	17.2	1,028	27,340
Nov.	22,396	21,271	17.4	....	27,680

Source: U. S. Bureau of Mines.
Notes: (a) Solid and semi-solid products of less than 200 penetration. (b) Includes prophyllite and ground soapstone. (c) Does not include precipitated antimony sulfide as in previous years. (d) Negligible. (e) Estimated.

Cotton, Rayon and Nylon Tire Fabrics

(In Thousands of Pounds)

	Production					Stocks[b]	
	Rayon Tire Cord Net Woven	Rayon Tire Cord Woven	Cotton and Nylon Cord & Fabric[a]	Chafer Fabrics (all fibers)	Total Tire Cord and Fabric	Cotton and Nylon Cord & Fabric	Rayon Cord and Fabric
1957:							
Jan.-Mar.	21,853	68,825	31,393	11,028	123,182	11,844	37,153
Apr.-June	16,037	63,195	35,308	10,456	115,418	13,428	13,473
July-Sept.	10,509	54,968	33,477	9,147	100,091	13,305	36,388
Oct.-Dec.	9,216	58,392	32,827	10,176	101,687	14,909	29,632
Total	57,615	245,380	133,005	40,807	440,378	53,486	116,646
1958:							
Jan.-Mar.	8,372	56,522	25,647	7,367	92,924	11,255	33,913
Apr.-June	.....	.....	30,745	6,020	80,533	11,274	26,327
July-Sept.	.....	.....	31,371	6,467	91,984	11,229	26,428
Oct.-Dec.	.....	.....	34,858	8,466	107,352	12,251	25,936
Total	8,372	56,522	122,621	28,320	372,793	46,009	112,604

Source: Bureau of the Census, U. S. Department of Commerce.
Notes: (a) Combined to avoid disclosing figures for individual companies. (b) At end of period.

Gasoline Consumption

(In Thousands of Barrels of 42 Gallons)

	1952	1953	1954	1955	1956	1957	1958
Jan.	86,863	89,634	89,852	96,397	100,642	109,295	107,281
Feb.	82,043	86,458	86,206	88,464	98,088	96,694	95,516
Mar.	87,065	98,158	101,549	105,684	112,412	113,166	108,914
Apr.	98,563	102,044	103,866	111,116	113,034	115,820	118,477
May	101,137	105,918	104,418	115,707	123,560	124,325	125,137
June	99,305	114,703	113,037	120,710	126,838	121,598	125,444
July	105,307	112,969	112,231	115,653	120,708	130,251	130,903
Aug.	102,954	109,124	110,223	121,816	125,847	128,808	129,925
Sept.	100,095	106,158	104,706	113,379	111,574	113,567	120,389
Oct.	103,689	106,037	105,607	112,558	119,204	119,334	125,267
Nov.	91,326	99,210	102,393	109,212	112,113	107,705	.....
Dec.	95,817	100,225	104,258	111,034	108,096	112,691	.....
Total	1,154,254	1,230,629	1,238,346	1,321,730	1,372,116	1,393,254	.....

Source: U. S. Bureau of Mines.

U. S. Gross Imports of Balata, Jelutong, Gutta-Percha, etc.

(All Quantities in Long Tons)

Year	Balata		Jelutong		Gutta-Percha & Other Guttas	
	Tons	Value	Tons	Value	Tons	Value
1945	1,361	907,253	....	.....	36	21,970
1946	2,281	2,233,065	304	256,169	423	458,064
1947	1,982	2,276,531	2,878	1,496,887	392	779,591
1948	1,195	805,078	3,401	2,377,765	423	542,788
1949	1,391	814,554	1,043	834,978	197	189,021
1950	2,117	1,589,885	1,789	1,515,162	541	745,418
1951	2,452	1,973,271	1,669	2,608,359	383	430,539
1952	988	762,994	1,636	2,094,983	282	385,890
1953	1,619	866,248	1,027	1,166,837	235	303,116
1954	949	504,065	2,196	2,624,926	417	511,055
1955	1,022	967,369	1,679	1,731,821	284	318,115
1956	1,396	1,111,165	1,851	1,909,447	290	309,615
1957	1,037	670,821	1,680	1,942,067	230	270,487
1958:						
Jan.	10	9,732	122	132,581	6	12,975
Feb.	4	3,390	46	45,507	7	19,454
Mar.	33	21,631	98	98,250	8	13,126
Apr.	6	2,787	74	75,302	17	19,187
May	242	131,642	131	151,130	22	35,366
June	16	11,515	89	108,419	21	28,739
July	19	12,359	201	254,075	42	45,692
Aug.	53	36,666	135	149,918	10	16,675
Sept.	97	29,775	129	189,219	13	10,199
Oct.	39	83,128	165	123,167	6	16,300

Source: U. S. Department of Commerce.

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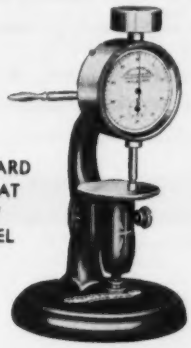

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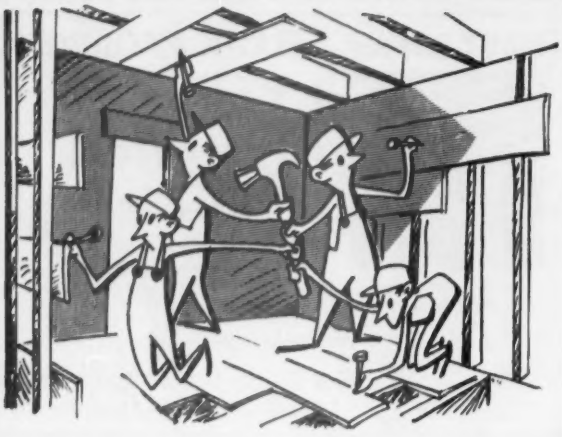

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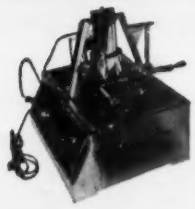

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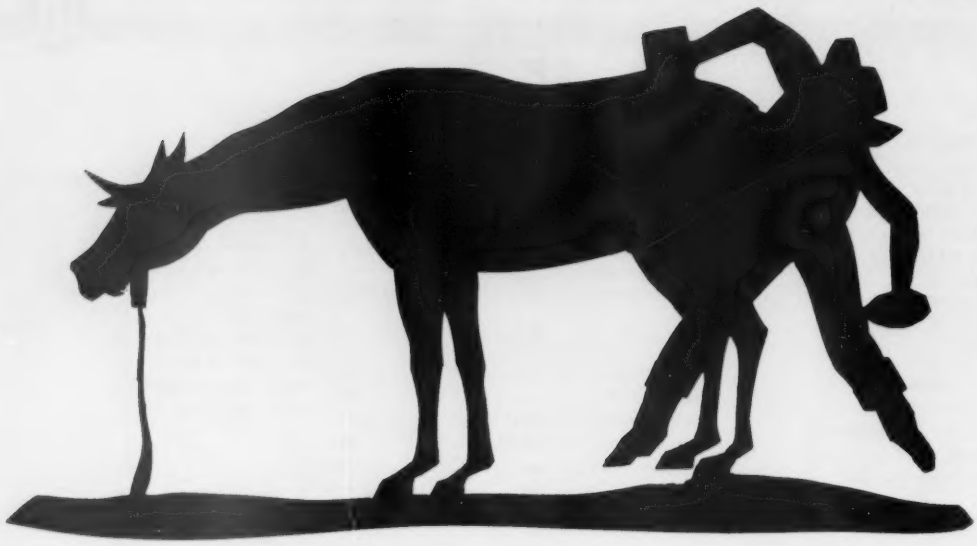

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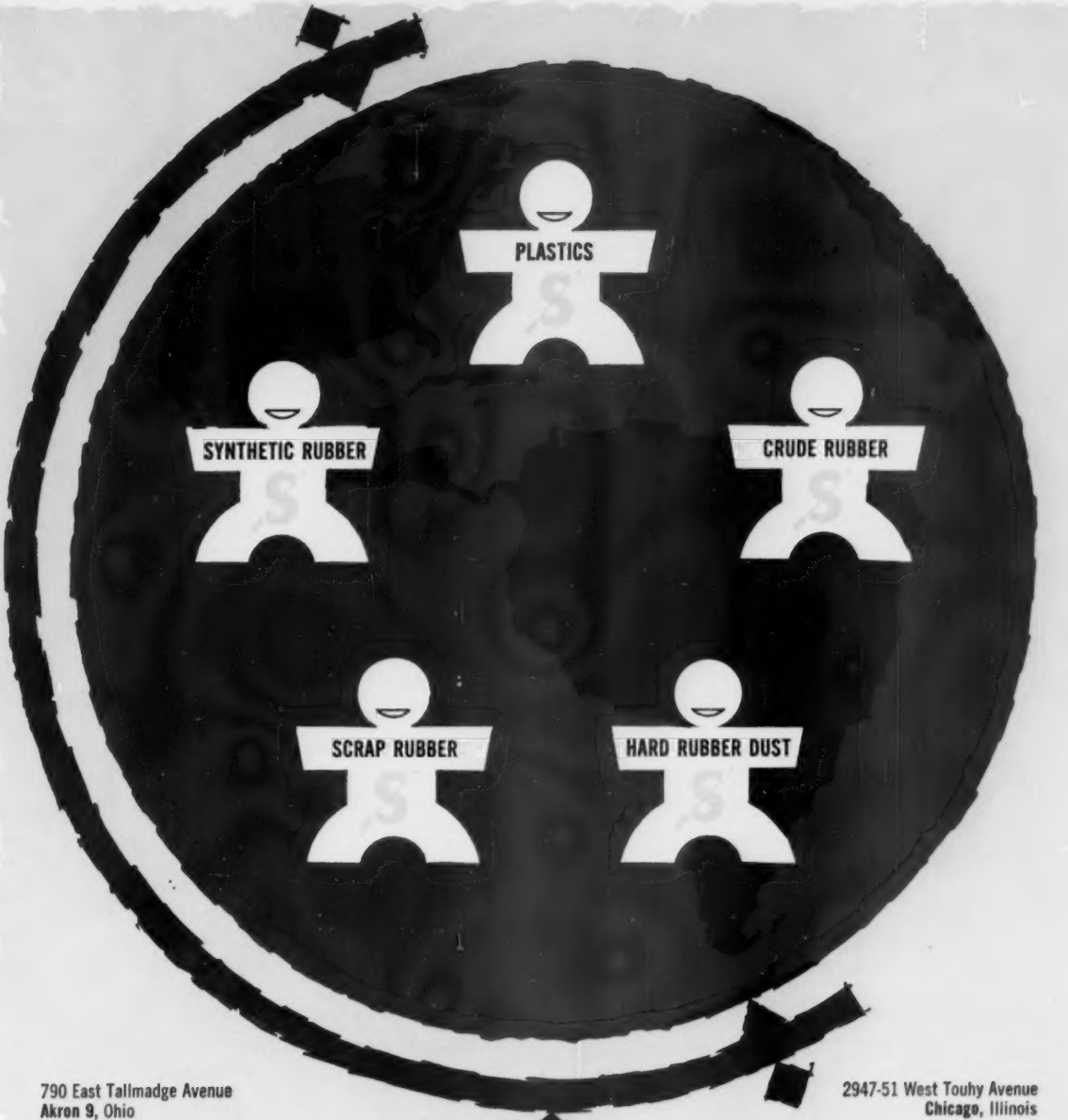

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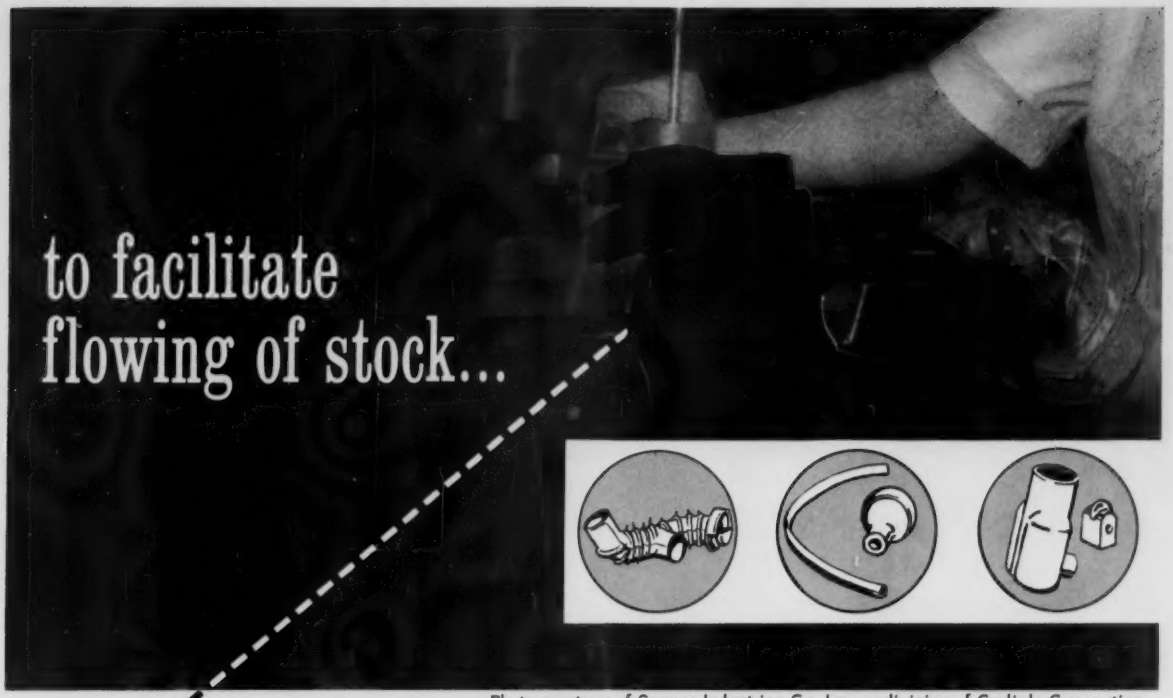

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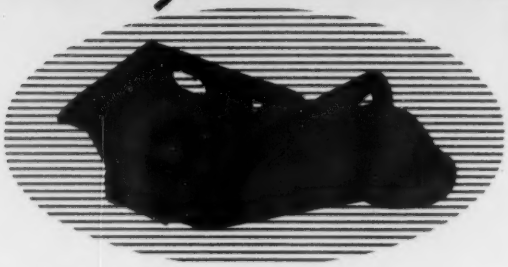

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